IMPACT OF THE PROPOSED LIBBY DAM UPON THE FOREST ECONOMY OF LINCOLN COUNTY, MONTANA

A REPORT
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IMPACT OF THE PROPOSED LIBBY DAM UPON THE FOREST ECONOMY OF LINCOLN COUNTY, MONTANA

A study by

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FOREWORD

There are a number of potential dam sites in the Rocky Mountain portion of the Columbia Basin. As dams are built in these places and the valleys inundated, it is going to be extremely important that the transportation facilities forced out of the valleys be relocated and rebuilt in such a way as not to throw an extra load on the development of local resources and functioning of local communities. Construction of the Hungry Horse dam brought the Forest Service face to face with this problem. The proposed construction of Libby dam raises it again. In both cases the manner of restoring transportation facilities will be key factors in the administration, development, and utilization of large areas of national forest land.

Conscious of the importance of sound transportation planning, the Department of the Army, Corps of Engineers has joined the Forest Service in sponsoring this study and has made money available from its planning funds to finance the study. The Forest Service alone, however, is responsible for the findings, conclusions, and recommendations presented in the following pages. A number of people in the Forest Service have aided in this project in addition to the four men listed as authors. I wish to express particular appreciation to the Northern Rocky Mountain Forest and Range Experiment Station which, in addition to supplying one member of the study team, has provided helpful counsel in guiding the study.

P. D. Hanson

P. D. HANSON, Regional Forester

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INTRODUCTION

For two decades the Nation has vigorously pursued the task of harnessing the tremendous energy which rushes down to the Pacific Ocean in the rivers of the Northwest. This job is only partly done. Many more dams will have to be built before the water resource can make its full contribution to the development of this region. The task ahead, however, is more than one of engineering alone. It also involves land utilization and coordinated resource development.

The interrelationship of dam building to the development of the farm, forest, and mineral resources is a problem of many facets. This report will direct its attention primarily to one aspect of the problem: the disruption of resource development behind the proposed Libby dam which would be caused by the reservoir, and the measures necessary to minimize the adverse impacts.

A word about Libby dam itself. It will be a big one (figure 1). One proposal being considered by the Corps of Engineers would involve an expenditure of 284 million dollars and would create a reservoir 107 miles long, 42 miles of which would be in Canada. On the other hand, the dam would create big benefits in the way of flood control and power generation. It is estimated by the Corps of Engineers that benefits from the dam at the above location would exceed the costs in the ratio of about 2 to 1.

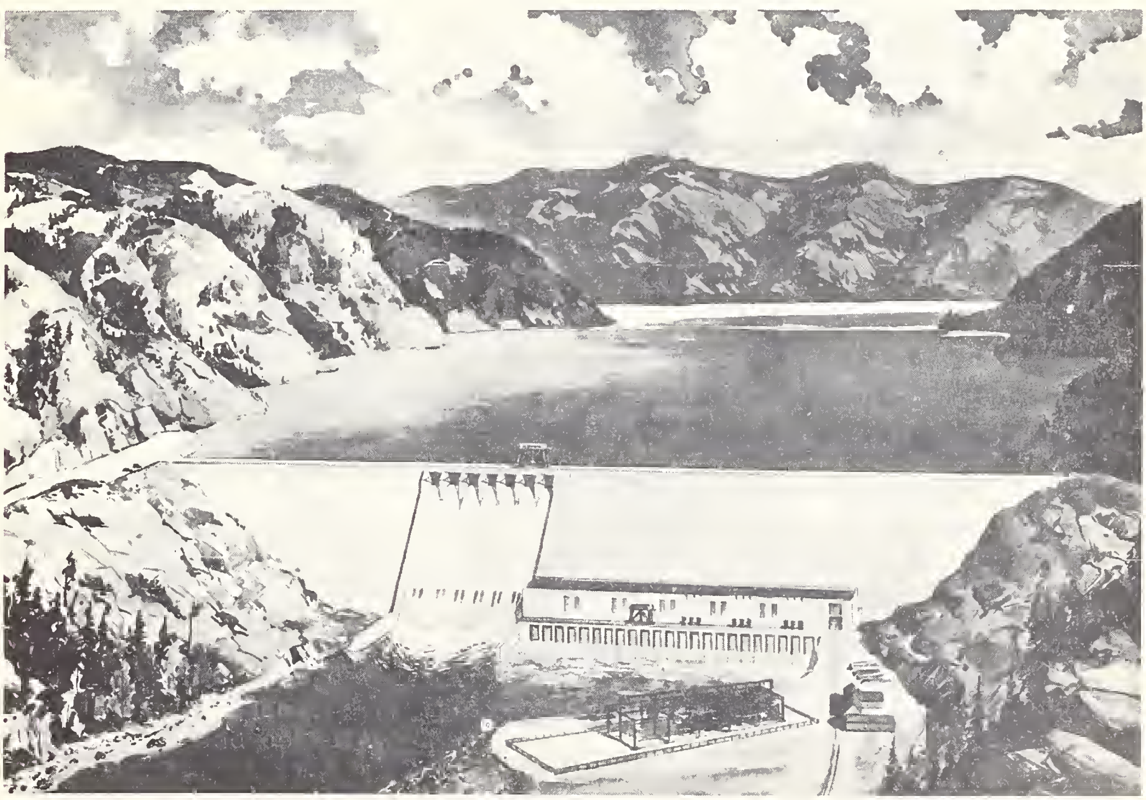


Figure 1. Artist's sketch of the proposed Libby dam.

The Kootenai River above Libby is favored by having a number of sites suitable for construction of a dam. No one of them has definitely been selected yet, which complicates this study. However, in the absence of this decision, we have considered two locations which appear the most likely choices:

1. Mile 204.9 above the confluence of the Kootenai and Columbia Rivers, approximately 3 miles above Libby.

2. Mile 217.0 above the confluence of the Kootenai and Columbia Rivers, approximately 15 miles above Libby.

Another uncertainty which has hampered the study is the future location of the railroad from Stryker to Libby. In the absence of a fire commitment from the Corps of Engineers it has been assumed that if the dam were located at the lower site the rail line from Stryker would follow Fortine and Wolf Creeks to the Fisher River, up the Fisher River to US Highway 2 and along the highway to Libby. Subsequent to the start of this study considerable interest has been shown in a route which would go down the Fisher River (instead of up it) along the the reservoir to the dam and thence to Libby. Such a location would, of course, have a different effect on log transportation costs than the route assumed. However, for the county as a whole the differences would be minor and they certainly would not change the conclusions reached in this report. For the upper dam site it has been assumed the railroad would follow Fortine and Wolf Creeks, turning down the Fisher River to join the present mainline at the mouth of that river.

Three alternatives for restoring transportation and other facilities related to forest management and development have been analyzed in considerable detail for Dam Site 204.9. These have been called Studies 1, 2, and 3. Two alternatives have been analyzed for Dam Site 217.0. They have been called Studies 4 and 5. For the purpose of measuring the adequacy of these plans, we have analyzed the existing transportation system and other facilities as they would ultimately be developed to adequately serve the area. This analysis is called Study 0.

The limits of this planning project should be clearly recognized. The data herein have no particular bearing on the question of where the displaced section of the Great Northern Railway mainline should be relocated. Furthermore, this report presents only part of the facts relative to a desirable location for the dam itself. There are a number of other factors to be taken into account in this connection, some of which are, no doubt, more important. The following pages, however, do show two things very clearly. First is the importance to the local economy of adequate restoration of transportation facilities. Secondly, these analyses suggest an equitable solution to the transportation problem if the dam were located at either Mile 204.9 or Mile 217.0.

SUMMARY OF FINDINGS AND CONCLUSIONS

It is more common to view a big dam as an engineering masterpiece than a major alteration of the geography in the locality where it is built. Yet, in many cases the geographical effects are important and far reaching. This is particularly true in the outer rim of the Columbia Basin where rugged topography has squeezed the bulk of human activities--homes, industries, farms, and travel--into the larger valleys. Libby dam is one of the structures which would have important geographical effects. The most important of these effects relates to transportation. Not only would the reservoir drown out key transportation facilities forcing their relocation in less favorable places, it would become something of a barrier to transportation itself.

These analyses have shown that so far as this locality is concerned one of the most important considerations relating to Libby dam is the design of the postdam transportation system. Anything which materially increases the cost or difficulty of transportation will hamper the development of Lincoln County.

The restoration of facilities which would be desirable behind a dam at River Mile 204.9 or 217.0 depends in part on the extent to which the reservoir could be used for travel and transportation. This study indicates that within certain limits towing of logs and cordwood is both feasible and desirable. However, the water level would fluctuate a hundred or more feet during the year making it very difficult to get wood in or out of the water during some periods. Moreover, the lake would ordinarily be frozen over during some winter months. Thus, water transportation cannot entirely supplant the railroad and roads for wood hauling. A water route would completely fail to meet the needs of public and administrative travel and transportation especially that required for fire protection. A considerable road network is necessary for proper functioning of the local economy and forest administration.

In selecting a suitable transportation plan there are several choices to make with regard to location and class of roads. One possibility is the relocation of Montana Highway 37 more or less along the reservoir with a bridge crossing the reservoir at the north end. Such a location of the highway would be expensive because of the heavy rockwork involved. The bridge would be expensive because of its length and unusual height. On the other hand, both the reservoir road and the bridge would greatly facilitate local transportation. Another alternative would be to route the highway away from the reservoir and to eliminate the bridge crossing and the expensive rockwork. Other roads would, of course, be required in either case.

These two basic alternatives were compared for the upper and lower dam sites. In the case of the lower dam site (204.9) the plan with a road along the reservoir and a bridge across it proves to be the best solution to the transportation problem.

In the case of the upper site (217.0) the plan with a highway away from the reservoir and no reservoir crossing has a considerable advantage so far as measurable costs are concerned. However, this plan increases the risk of large destructive forest fires and does not offer sufficient flexibility of transportation. For that reason, a compromise solution to the upper dam problem seems desirable. This compromise would involve both routing Highway 37 away from the reservoir and building a bridge. Table 1 shows the cost of the facilities which we believe should be constructed at the time the dam is built as part of the dam project.

Table 2 shows that the recommended plan in each dam site would accomplish the very important objective of minimizing the impact of the dam upon the local economy. In the case of the lower site, wood procurement, administration, public travel, and other activities would cost about $52,000 a year more than if there were no dam. The increase for the upper dam site would be $3,900 annually. When the initial facilities costs are converted to an annual basis and added to the impact costs, the total annual cost of the recommended restoration plan for the lower dam site is $611,400 a year; for the upper dam site the recommended plan would cost $432,800 a year.

Table 1. Recommended restoration of facilities relating to forest development and management if Libby dam is built

Item	Dam Site 204.9	Dam Site 217.0
	- Thousand dollars -	
State Highway 37	16,522	3,990
All other roads	6,195	13,801
Trails	66	-
Landing field	209	-
Communications	315	250
Ranger stations	275	275
Water transportation facilities	477	477
Recreational facilities	40	40
Total	24,099	18,833
Investment required in existing roads if no dam is built	2,752	2,631
Net cost	21,347	16,202

Table 2. Total annual cost of recommended restoration plans for roads and other facilities relating to forest development and management

	Dam Site 204.9	Dam Site 217.0
	- - - Dollars - - -	
Initial cost of facilities	559,300	428,900
Increase on annual operating cost above present	52,100	3,900
Total	611,400	432,800

THE IMPORTANCE OF THE FOREST IN LINCOLN COUNTY

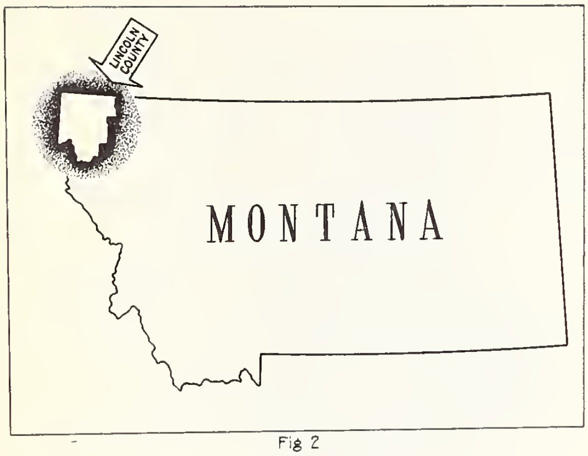


Fig 2

Lincoln County lies in the most densely timbered portion of Montana (figure 2). Ninety-five percent of its 3700 square miles is forest. Farmlands are scattered along the main valleys but the only nonforest area of any magnitude is a patch about a township in size lying north of Eureka. Table 3 shows the acreage in various categories.

With so much of the County forested, it is not surprising that timber is economically the most important resource in the locality. More people depend upon the forest resource for livelihood than upon any other. In 1950, for example, the gross value of the timber products output was $10,700,000. This was 10 times larger than the 1950 farm production which amounted to $1,003,000. It was not quite 6 times larger than the 1950 mineral production of $1,900,000.

Employment statistics tell the same general story. The County derives most of its income from 4 sources (1) forestry and forest product plants, (2) mining, (3) the Great Northern Railway, and (4) farming. Approximately 1200 persons are employed in forestry and the forest products industry. This is about twice the total labor force of the other three basic industries combined.

Table 3. Land areas in Lincoln County

	Acres
Cultivated land and improved pasture	23,000
Natural grassland	13,000
Forests	2,269,000
Waste, roads, barren, brush, railroad, etc.	65,000
Townsites	2,000
Riverbeds and sloughs	6,000
Total	2,378,000

Neither agriculture, mining, nor forestry has yet fully developed in Lincoln County. It appears possible to substantially increase the agricultural income by converting an additional acreage to crops and by intensifying farming practices. The mining potential is more difficult to appraise but present geologic data indicate mineral resources are sufficient to support for many years a somewhat larger industry than the present one. Even so, these expansion potentials are greatly overshadowed by the opportunities for future timber development. With some intensification of manufacturing by the lumber and pole plants and the establishment of a local pulp and paper mill, the combined output of all these plants could rise to approximately 34 million dollars a year. This is two-thirds of the value of the timber output in all of Montana during 1950. Figure 3, which summarizes these data, shows that the forest will continue to be a major factor in the lives of the people of Lincoln County.

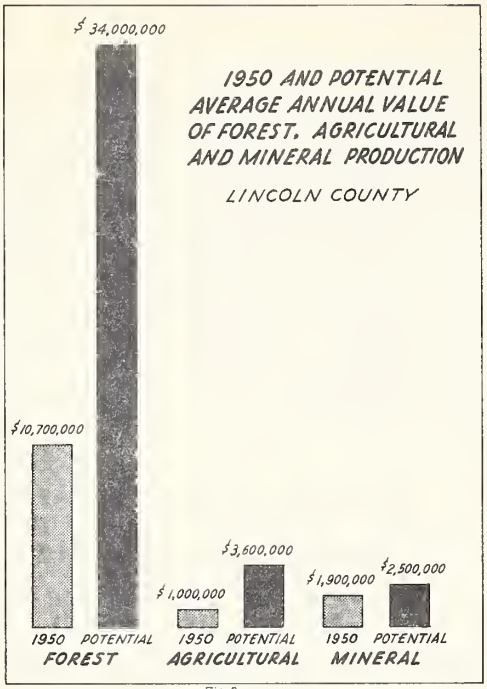


Fig 3

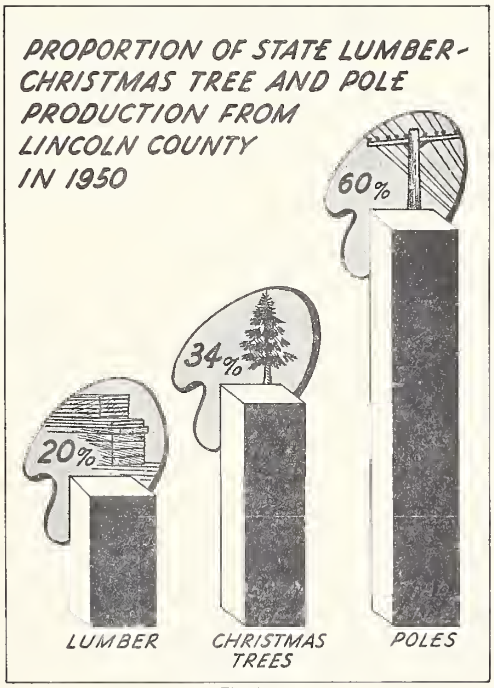


Fig. 4

In addition to being the mainspring of the local economy, the forest industry of Lincoln County is a substantial part of the total forest industry in the State. With but $2\frac{1}{2}$ percent of the State area, the County includes 12 percent of the commercial forest and almost one-fifth of the total timber-growing capacity of the State. The $10,700,000 worth of timber products produced in Lincoln County in 1950 was approximately one-fifth of the total State output of these products (figure 4).

The area included in this analysis and its forest resources

All or part of several distinct topographic and national forest administration units lie within Lincoln County. The dam and the reservoir both would be in the unit designated as the Libby Working Circle in figure 5. However, the impacts of the dam and the reservoir would also be an important factor in the management and development of the Troy Working Circle. Therefore, the following analysis covers both working circles, which we shall refer to collectively as the Libby-Troy Working Circle.

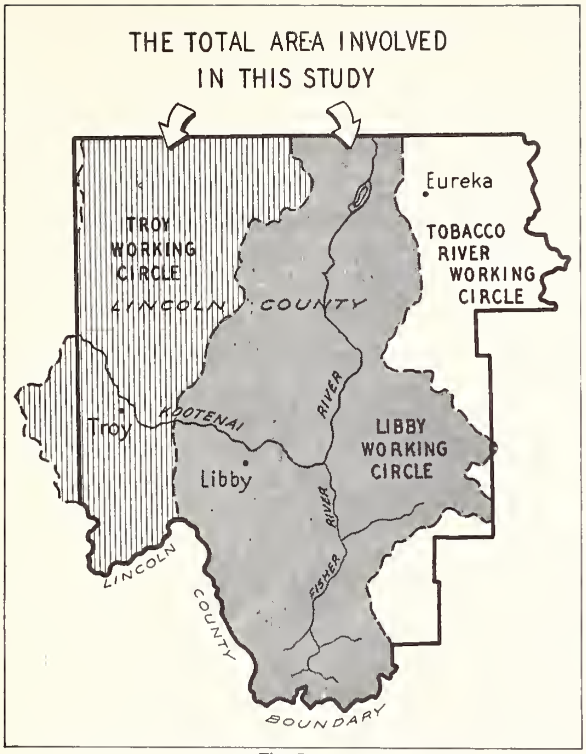


Fig 5

The Libby-Troy Working Circle has a total area of 1,935,000 acres

98 percent of the total area is forested 1,896,000 acres

80 percent of the total area is commercial forest 1,574,000 acres

80 percent of the commercial forest is publicly owned:

J. Neils Lumber Company	169,000	acres
Other large private	70,000	"
Small private	87,000	"
State of Montana	31,000	"
Public domain	4,000	"
County	2,000	"
National forest	1,211,000	"
Total	1,574,000	"

The commercial forest can sustain an annual sawtimber cut of 135,980,000 board feet, log scale.

It can in addition sustain a large annual cut of other green wood of 179,000 cords.

The year 1891 is one of special significance so far as Lincoln County is concerned. It was then the track layers of the Great Northern Railway completed their task and linked this northwest corner of Montana with the outside world. Their accomplishment breathed economic life into a virgin wilderness rich with assets. The saws began to ring in earnest and the lumber industry which was to provide the principal livelihood of the County was born.

Perhaps the most significant thing today, after six decades of growth, is that industrially speaking the forest has not come to full production even yet. It can annually produce a greater volume of timber than is now being cut. Certain economic shackles have prevented full development of the resource during the first six decades of its use. Many will ask, of course, whether these shackles will ever be completely removed. Time alone will give us the true answer, but there appears to be justification for a "conditional optimism." In other words, the long-range economic prospects appear brighter than ever before. Nevertheless, Lincoln County has a congenital weakness. From a freight rate standpoint it is one of the "farthest away" places in the United States. That is a fact it must live with and a fact which makes it particularly desirable to avoid any substantial increase in timber production costs.

The lumber industry

Sawmills have taken most of the timber cut in Lincoln County up to the present. The first one began operating in Libby during the winter of 1891 and 1892. By 1916, there were 4 relatively large plants in operation which cut a total of 137 million board feet that year. However, the industry went into a sharp decline long before the depression of the 1930's struck its blow. From 1924 to 1928 three of the 4 big sawmills shut down. Only the one at Libby kept operating. This plant, presently owned by the J. Neils Lumber Company, was the sole sawmill of any size in the County until another was built in Troy in 1948. This mill was acquired by the J. Neils Lumber Company in 1951.

The sawmills which shut down in the 1920's did not run out of wood. There was still plenty of timber close to each of them. The total lumber production during several years may have been somewhat higher than the forest could support permanently, but it certainly was not high enough to cause the sudden death of 3 concerns. For an explanation of what happened, we need to look outside the County. The local lumber industry has suffered from lack of markets rather than lack of timber.

The trees in this area fall into two categories (1) the "gilt edge" timber; namely, white pine and ponderosa pine which because of their special qualities always have enjoyed a fairly strong market position and (2) the less select woods such as larch, Douglas-fir, spruce, and lodgepole pine which compete in the rough-and-tumble general market and which have in the past suffered on that account.

During the early expansion days, the demand for the secondary species was strong. Few production statistics are available for that period but data for 1923--just before the industry went into a decline--indicate that 70 percent of the output of the 4 big mills in Lincoln County was larch and Douglas-fir. It appears much of that lumber was shipped to eastern Montana which was enjoying a big agricultural boom during the first two decades of the century.

The bottom fell out of this market during the 1920's because of dry years which caused failures in dryland farming and because of postwar farm problems in general. About the same time the easier and cheaper logging chances in Lincoln County became scarcer and the United States lumber market more competitive. This unhappy combination of facts discouraged the production of lumber of the secondary species for a number of years. As a matter of fact, except for railroad ties and mine timbers, there was not much sawed material of secondary species produced in western Montana from the middle 1920's until World War II. The state of the market is indicated by the fact that during much of this period thick slabs were left behind by railroad tie mills to be used for fuel or allowed to rot, although the wood in them would have made clear knot-free lumber.

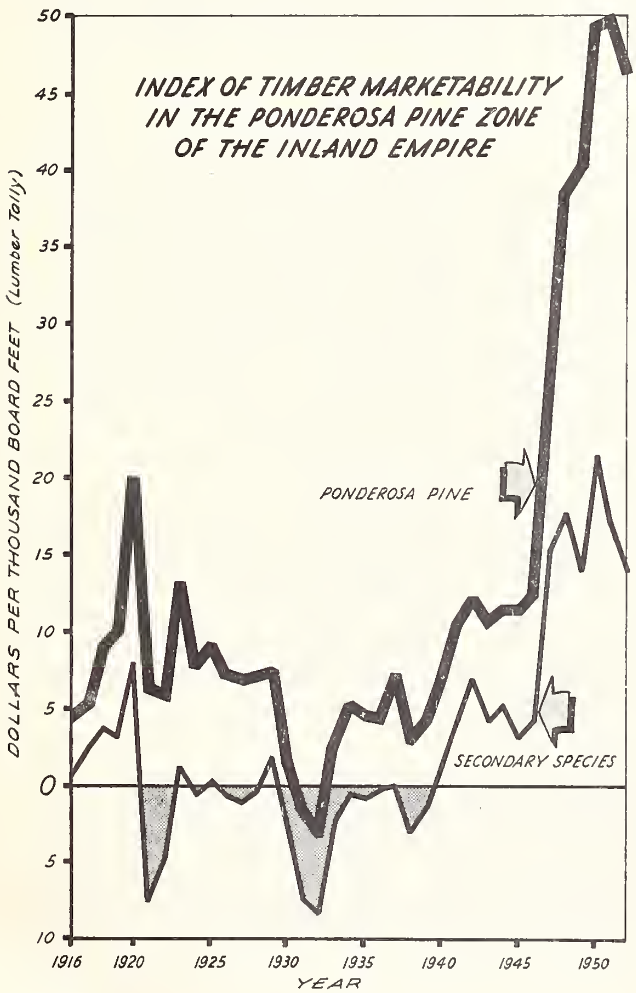


Fig 6

Figure 6 shows the long-time trend of marketability of ponderosa pine and of the secondary species. The index in this chart is actually the margin between average wholesale lumber values and average lumber-producing costs. Out of this margin comes the cost of the stumpage and profits. A comparison of average selling values with average production costs does not, of course, indicate how much lumber of secondary species was produced at a profit during any year, for in years of narrow margin the bulk of the output of the less valuable species was produced by mills whose costs were below average. Moreover, in many cases, it was possible to log the secondary species because the roads and other development costs were already paid for by ponderosa and white pine timber. The chart does, nevertheless, provide a valuable clue as to the

relative marketability of the two classes of timber over the years. During only 2 years, from 1916 through 1939, did the ponderosa pine index drop below zero. On the other hand, the index for the secondary species was minus in 15 of these 24 years and in only one year was there a plus margin of any size.

Coincident with the entry of the United States into World War II, the secondary species came into increased demand. A decade of favorable margins since then gives weight to the conclusion that we are entering a new and favorable era so far as these species are concerned. Their present improved market outlook appears attributable to several factors listed below:

1. The great expansion of the lumber market during the war and post-war period.

2. A progressively tighter timber supply situation for the Nation as a whole, including a growing scarcity of better species such as ponderosa pine.

3. A decline in the average quality of lumber from the South and West Coast, particularly the latter. Larch and inland Douglas-fir dimension lumber, which was once regarded as second-rate in comparison with virgin Coast fir, is now proving to be as good as or better than some of the second-growth Coast fir.

4. Improvement in the manufacturing and drying of the secondary species in this region, a situation induced by the greater value of these species.

5. Government efforts to stabilize the national economy at a fairly high level and prevent a recurrence of severe economic setbacks.

As the market position of the secondary species has improved, lumber output of these species has increased. Figure 7 shows the trend in percentage of larch and Douglas-fir in the J. Neils Lumber Company production since 1936.

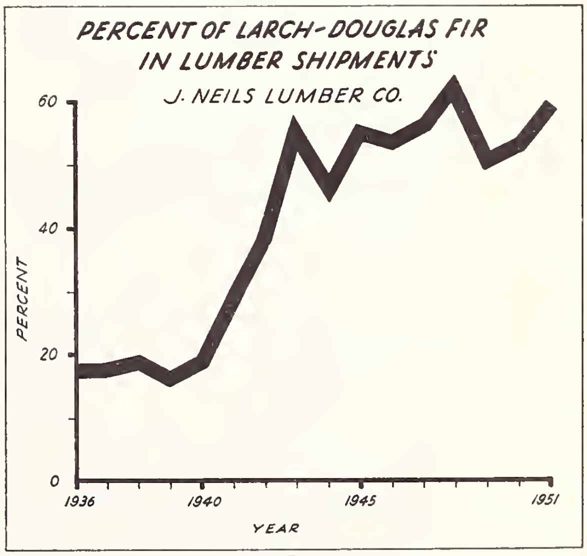


Fig. 7

Pulp and paper industry

One of the early dreams of Lincoln County was of a pulp and paper mill receiving its power from a dam at Kootenai Falls on the Kootenai River. Since then, the pulp industry of the United States has expanded fivefold, but Lincoln County, like most of the Rocky Mountain Region, has not shared in that expansion. In fact, the

one and only pulpmill using virgin wood pulp in all the Rocky Mountain States began operating at Lewiston, Idaho in 1951.[1] Without a doubt, the same market handicaps which have held back the lumber industry have caused the pulpmills to shun the vast supplies of fine timber in the Rocky Mountains.

However, in the past few years there have been some fundamental changes in the economic picture. The far West is experiencing a dramatic population and industrial growth which is creating a larger nearby market for Montana timber. We have also seen a tightening of the timber supply situation over the United States as a whole. Wood-using industries have had some difficulty satisfying all their timber needs. These national timber supply trends, together with the steadily expanding demands for pulp and paper products, encourage the belief that the pulp industry will sooner or later do some of its expanding in this region. The 8 states in this region contain one of the last great reservoirs of undeveloped timber in the country. We have here 10 percent of the commercial forest land in Continental United States and 14 percent of the softwood sawtimber, including several species highly desirable for pulping. It remains to be seen whether any of the pulpmills built in this region will be located in Lincoln County. However, as we have already said, the outlook is very encouraging. This is one of the more heavily forested portions of the Rocky Mountains and as will be shown later, it has a large quantity of timber available for pulping.

The pole industry

Prior to World War II, production of utility poles in Montana did not amount to much. Then, almost overnight, output jumped from a few thousand to hundreds of thousands. Table 4 tells the story of the growth of this industry.

Table 4. Production of utility poles in Montana

1937	29,247
1946	301,322
1947	324,734
1948	166,856
1949	221,815
1950	148,473
1951	216,188

We can attribute the rapid rise of production to a greatly expanded program of utility construction by rural electrification cooperatives, private power companies, and public power agencies. Pole producers in the South and elsewhere were unable to meet the demands, so a drive was made to build up pole production in this region.

The J. Neils Lumber Company entered the pole business in 1946. It has grown to be the biggest producer in Montana, accounting for 60 percent of the State production in 1950, and at present it has the only pole yard in Lincoln County.

Table 4 might seem to indicate that the industry has already gone into a decline. According to I. V. Anderson, who has followed the development

1/However, the Inland Empire Paper Company of Spokane, Washington has for many years obtained wood in Idaho and Montana.

of this industry very closely, 1946 and 1947 are poor years with which to make comparisons. He points out that during both years pole output was greatly stimulated by a promotional drive, and that part of the decline since then must be charged off as growing pains of a new industry. Some of the concerns which started up were marginal and were unable to survive when the market resumed more normal proportions following 1947. The new Montana industry is majoring in lodgepole pine and larch. Neither species had been used for poles to any extent prior to World War II. Properly manufactured and treated, they are as good as any for this purpose, but as new products they represent a bigger marketing problem than species which have long since been completely accepted.

Anderson predicts that, in the long run, pole production in Montana will stabilize at a level which surpasses the record output of both 1946 and 1947. He bases this conclusion on the increasing difficulty of finding adequate pole timber in the eastern states, the abundance of timber here, and the suitability of much of it for poles.

Pole production has been more erratic than lumber production and that situation will no doubt continue. Production of smaller poles, which meet a maximum of competition, no doubt will fluctuate considerably in the future as it has in the past. However, the market for large poles, which are increasingly difficult to obtain elsewhere, should be relatively stable.

The over-all outlook

Development of the Lincoln County timber industry in the future will continue to depend largely on country-wide conditions as it has in the past. Certain national trends, therefore, become very significant.

In that connection, the President's Materials Policy Commission, in its report, Resources for Freedom, makes a statement with enormous implications:

> The decade of the 1940's marked a crucial turning point in the long-range materials position of the United States. Historical trends long in the making finally came to a climax when the national economy moved just prior to the war from a long period of depression into a period, still continuing, of high employment and production. By the mid-point of the twentieth century we had entered an era of new relationships between our needs and resources; our national economy had not merely grown up to its resource base, but in many important respects had outgrown it. We had completed our slow transition from a raw materials surplus Nation to a raw materials deficit Nation.

In analyzing the national wood supply situation, David T. Mason traces the prewar timber surplus back to the construction of the Panama Canal which, because of low cost water transportation, opened East Coast and world markets to a "long-continued deluge of lumber from the great quantity of highly-accessible, high-quality, heavy-stand-per-acre,

low-cost-of-operation, low-value timber of the West Coast."[2] Sawmill capacity was consequently built much beyond the needs of the Nation even for the good markets of the 1920's. Mason points out that the conditions during World War II were more or less hidden by a blanket of fog which did not lift until price ceilings were removed in 1946. At that time it became quite obvious that the situation had vastly changed. Much of the surplus timber had been cut. Much more had been taken from rapid liquidation and placed on a sustained yield basis or hoarded by private and public owners.

The changes described by Mason have served to demonstrate that this is no longer a wood-surplus Nation and to underscore long-range observations by the Materials Policy Commission and the Forest Service relating to the future timber supply situation. The above-mentioned commission report states:

> In 1975, if present trends in forestry continue, annual growth of sawtimber may average between 40 and 42 billion board feet. Projected timber requirements, plus losses of 2.1 billion board feet a year through fire and epidemics (half the present annual loss is from those causes), would result in a total drain of more than 66 billion board feet a year. Thus, unless current trends can be modified, sawtimber drain in 1975 might exceed the domestic growth of trees capable of being used for sawtimber by more than 50 percent.

The fact of tightening timber supply for the Nation as a whole would certainly appear to enhance the prospects of full development of Lincoln County's timber industry. There are, however, certain adverse factors which should be considered. For one thing, Lincoln County, like the rest of this region, still operates under a handicap relative to producing and marketing timber. This handicap penalizes the secondary species. That the handicap exists is clearly evidenced by the absence of any pulpmills in Montana. Notwithstanding the abundant timber supplies of this State, the pulp companies still find greener pastures elsewhere. The handicaps are apparent also in the severe distress relatively small price declines have caused producers of lumber of secondary species.

Out of these seemingly conflicting facts we may draw the following conclusions:

> The over-all outlook is for an expanding market for the timber of this area.
>
> The timber industry of this region does, however, operate at a disadvantage in relation to the industry in many other parts of the United States. Thus, any substantial increase in operating costs would increase that disadvantage and would retard, if not reduce, the growth of the local timber industry.

2/From a paper by David T. Mason delivered at a joint meeting of the Canadian Institute of Forestry and the Society of American Foresters, Montreal, P.Q., November 19, 1952.

Timber supplies

As already pointed out, the allowable sawtimber cut of the Libby-Troy Working Circle is 136 million board feet a year. The flowage area created by the dam would reduce it to 134 million board feet. In time, as forestry and utilization improve, no doubt a higher cut can be sustained. Even an allowable cut of 134 million board feet will permit some expansion of cutting, for the actual cut of 1951 was 114 million board feet. The bigger opportunity for expansion is in nonsawlog material, that is, tops of sawtimber trees, understory trees 5 to 11 inches in diameter in sawtimber stands, and trees of that size in younger stands which should be thinned. Excluding the area within the probable flowage, there is enough of this material to sustain an annual harvest of 176,000 cords.

How the industry will develop to take advantage of the presently unutilized timber supplies is difficult to say. It appears, however, that full use of the available wood will not be an accomplished fact until a pulpmill is constructed somewhere in this vicinity. A local pulpmill would probably encroach somewhat upon the sawtimber supplies of existing industries. However, it would also provide an outlet for great quantities of wood for which there is now no market. Table 5 summarizes the resource situation.

Table 5. 1951 timber utilization compared with allowable cut[1]

	1951	Allowable
Sawlogs--thousand board feet	114,000	134,000
Tops, cull, understory trees--cords	Negligible	176,000
Sawmill waste--cords	" except for fuel	70,000

1/As an element of conservatism, no dead wood is included in these allowable cut figures though there is a good deal of it which could be used for various purposes.

LOCAL INFLUENCES OF A DAM

It is impossible to build a big dam, create a long lake, and generate a large volume of electricity without some major effects in the locality where that occurs. The Libby dam, if it were built, would be no exception. With the first shovelful of dirt, a boom would start which would cause the local communities to bulge at their seams. Later these communities would find their income had been increased by the people employed to operate the dam and their industrial opportunities broadened by the availability of ample electric power. The County would suffer some reductions of income because productive land would be flooded. The economy of the area would be changed somewhat by the rearrangements in transportation facilities which the reservoir would make necessary and there would be other changes of various magnitudes.

A 425-foot dam at the lower site (Mile 204.9) would create a lake 107 miles long, backing water 42 miles into Canada. This lake would have a maximum elevation of 2459 feet above sea level and would flood approximately 38,000 acres in the County. Two small towns, Rexford with approximately 300 people and Warland with 39, would have to be abandoned or moved. Including the populations of these two towns, there are about 600 people living within the area that would be flooded by the dam. Approximately 56 miles of State Highway 37 and the same distance of mainline track of the Great Northern Railway would be inundated.

A dam at the upper site (Mile 217.0) with a highwater mark at the same elevation would, of course, create a somewhat shorter lake, flooding only 30,000 acres in the United States, and inundating only 44 miles of Highway 37 and Great Northern Railway. However, Rexford and Warland would still be in the reservoir area and the population dislocations would be but little less than for the lower dam site. Table 6 classifies the land which would be flooded in each case. In both cases a little less than one-tenth of the County's cultivated area would be flooded. Hay is the principal crop on this land, although potatoes and oats are also common. Figure 8 shows a typical farm scene.

Table 6. Character of land which would be flooded by a dam with a crest 2459 feet above sea level

	Lower site	Upper site
Cultivated and improved pasture	2,100	1,800
Natural grassland	7,000	6,200
Forests	15,500	10,100
Waste, barren, brush, roads, railroads, etc.	8,900	8,500
Townsites	200	200
Riverbeds, sloughs	4,300	3,400
Total	38,000	30,200

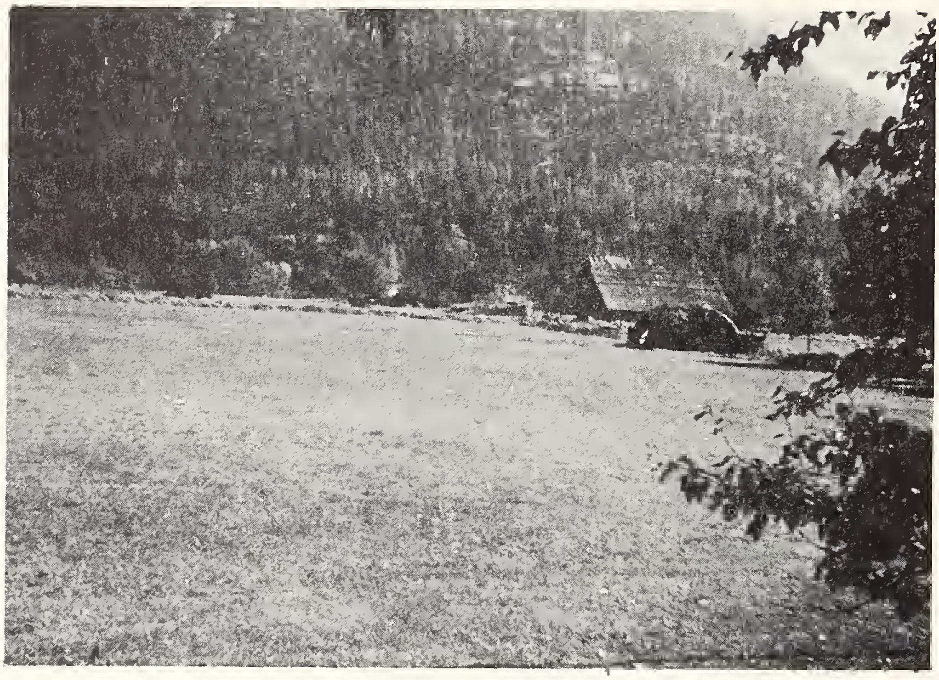


Figure 8. Typical agricultural land in the Kootenai Valley.

Less than 1 percent of the forest in the County would be removed from production and the loss of timber-growing capacity would likewise be small. Preliminary estimates of the Corps of Engineers indicate the land and improvements to be flooded by the dam at the lower site (not including the railroad, highways, and utilities) have a present value of about 9 million dollars. This is about 3 percent of the estimated total cost of the Libby dam project by the Corps of Engineers. Similar figures are not available for the upper site, but the cost probably would not be much less.

Calculations by the county assessor relative to the lower dam site show that about 3 percent of the local tax base would be submerged. Table 7 shows where the taxes come from now and how each source is likely to be affected. Several items in this table need to be explained. Reduction in tax payments by the Great Northern Railway would result from the fact that in relocating the mainline the mileage of track within Lincoln County would be shortened. The county assessor has assumed a route which would shorten the trackage 10 miles. Inasmuch as a major portion of the tax paid by the railroad is based on mileage, less track means less income to the County. Public utilities, town property, personal property, automobiles, merchandise, etc. account for about $6000 annually in taxes from the proposed flowage area. This has not been included as a net loss in table 7 as it seems likely that most of the population and concerns forced to move out of the flowage might locate elsewhere in the County.

Figure 9 shows that the school districts of Lincoln County are of odd shapes. This is the result of gerrymandering to give all but one of them a piece of the Great Northern Railway track so they may share in the large tax revenue from this railroad. In two of the districts 90 percent or more of the school taxes are paid by the railroad. Any major shift in the railroad location would upset the school tax picture and it would be necessary to revise district lines.

Table 7. Lincoln County tax revenue

	1951 tax revenue	Reduction likely to be caused by dam at lower site
	- - - Dollars	- - - -
Railroad	236,000	13,900
Farmland	31,000	5,200
Grazing land	13,000	2,500
Forest land	80,000	2,000
Forest industry	75,000	-
Mining industry	46,000	-
Public utilities	25,000	-
City and town property	66,000	-
Personal property--autos, merchandise, etc.	137,000	-
Total	709,000	23,600

Creation of a lake which would be relatively full in the summer would offer an added attraction to recreationists. From a wildlife standpoint, it would be both an advantage and a disadvantage. The principal wildlife problem in this County is an overpopulation of deer, with a consequent heavy pressure on the winter food supply of these animals. Flooding of several thousand acres of winter range intensifies this problem. On the other hand, the flooding out of a number of farms would reduce the demands for local livestock grazing, thus eliminating some competition from that source. In the overall, therefore, the reservoir would not be likely to seriously aggravate the big game situation.

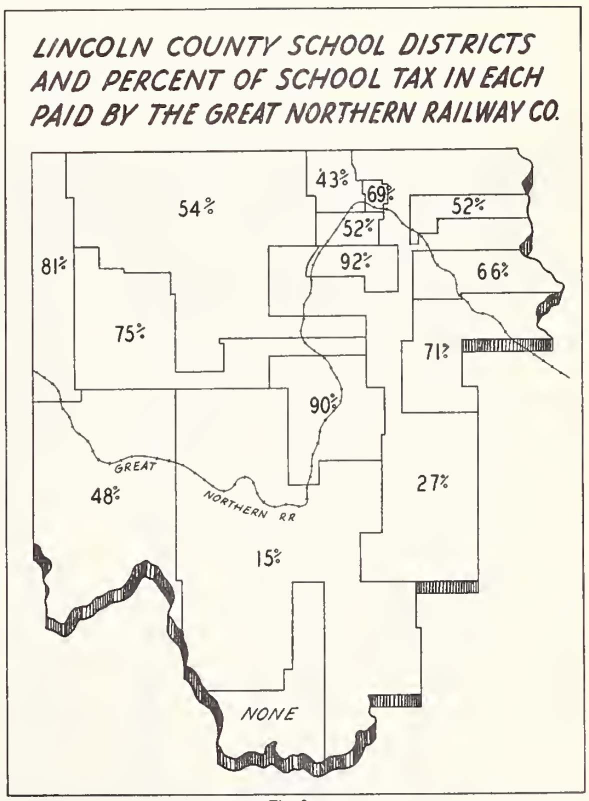


Fig 9

This is one place where a big dam might improve fishing. The present fish population of the Kootenai River is low because of a high silt content and low water

temperature. A large reservoir would act as a settling pond, thereby providing clearer water downstream. The surface of the reservoir would be warmer than the present stream. Thus, if the dam were designed to draw water from the upper levels of the reservoir, it would be contributing to better fishing. We are unable to judge the engineering feasibility of this idea, but it does illustrate the possibility of fitting the dam design to local situations not normally considered.

Fig. 10

The biggest change wrought by the dam would be on transportation

The sections of Highway 37 and Great Northern Railway which would be submerged are key arteries. If the dam is built at the lower site, the new location of these facilities and the water transportation on the reservoir will affect the cost and efficiency of travel and transportation to some degree on three-quarters of a million acres. This area will be referred to as the "Zone of Influence" in this report (figure 10). Construction of the dam at the upper site would eliminate the adverse impact in the Fisher River drainage. However, the railroad would be relocated in this drainage, thus benefiting wood procurement there. For that reason, the Zone of Influence of the upper dam site is larger than it might appear at first glance. For the sake of comparability, the transportation cost calculations for the upper dam site have been based on the Zone of Influence of the lower site as shown in figure 10.

The Zone of Influence constitutes a big part of the Libby-Troy Working Circle

This means that any substantial increase or decrease in transportation costs within the Zone of Influence will have an important effect in the economy of the entire Working Circle. Half of the commercial forest area in the Libby-Troy Working Circle is in the Zone of Influence. Likewise, the Zone of Influence includes almost half of the timber-growing capacity. Table 8 shows this.

Table 8. Proportion of Libby-Troy Working Circle annual allowable cut in Zone of Influence, Dam Site 204.9

	Working Circle	Zone of Influence
Sawtimber--million board feet	134	60
Cordwood--thousand cords	176	84

The stability of the timber industry depends upon developing a transportation plan which makes the winter logging area available during that season

The northwest corner of Montana is in a snow belt. Deep snows constitute a major handicap to logging, many areas being virtually locked up during the winter months for this reason. In fact, the logging engineers currently estimate that 82 percent of the commercial forest area in the Libby-Troy Working Circle is unsuitable for winter logging. Inasmuch as adverse winter conditions generally prevail for three months, winter logging areas are, therefore, at more or less a premium. Figure 12 indicates that from the standpoint of sustained yield management, the winter areas shown in figure 11 will fall 43 percent short of supplying the sawtimber cut desirable during that portion of the year. They will fall 46 percent short of supplying the desirable winter cut of cordwood.

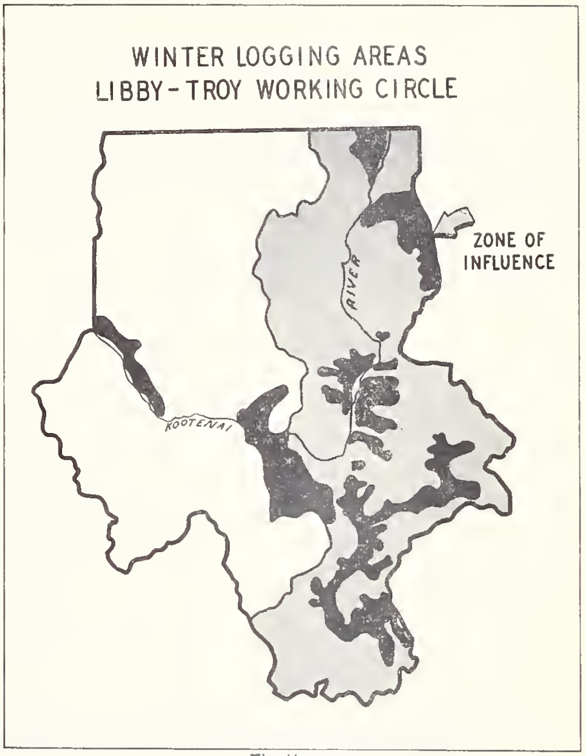


Fig. 11

These estimates are, of course, based on present methods, present equipment, and present experience. This leads us to believe that when the pressure for winter logging area becomes acute, some areas now considered as "fair weather chances" will be logged under adverse snow conditions. The problem is nonetheless important. For full and economical utilization of the timber resource in the Libby-Troy Working Circle it will be necessary to utilize all of the winter logging area for winter logging. This becomes a main consideration in the Libby dam planning because two-thirds of the sawtimber in the winter logging category in the entire Working Circle lies within the Zone of Influence. Likewise, two-thirds of the cordwood available for winter logging

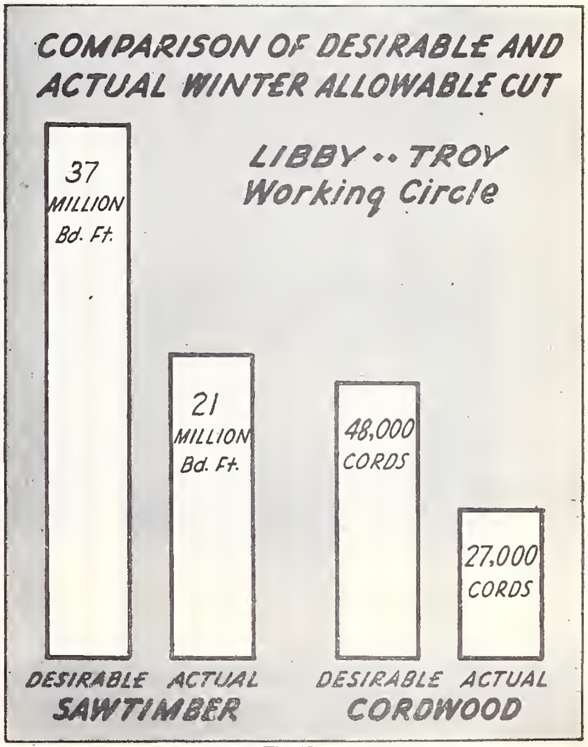


Fig. 12

is in the Zone of Influence (table 9). Needless to say, it is urgent to have a transportation system which makes it possible to operate these winter chances in the winter.

Table 9. Annual allowable cut available for winter logging

	Sawtimber	Cordwood
	Million bd.ft.	Thousand cords
Libby-Troy Working Circle	21	27
Zone of Influence	14	18

<u>Replacing the submerged roads would be much more expensive than their original construction even after taking account of the changed value of the dollar</u>

The transportation problem here is basically one of topography. On both sides of the Kootenai River the land is rugged and rocky, rising sharply to the mountains (figure 13). The rim of the basin is for the most part between 3000 and 4000 feet above the valley floor. Neither the steepness, rockiness, nor elevation contribute to easy transportation. As a consequence, the existing routes of the railway and the highway follow along the river. There is no place else they can be built without expensive construction. For example, the replacement value of the 63.4 miles of

Figure 13. The country along the Kootenai River is mountainous which makes road building outside the valley bottom expensive.

highway from the north end of the Libby bridge to Eureka is 2.5 million dollars in its present location. Expenditure of almost as much again would bring it up to state highway standards with 28 feet usable width and an asphalt mat surface. The total cost at present prices then would be 4.7 million dollars.

A similar highway above the highwater mark of the reservoir would be through solid rock much of the way, thus skyrocketing construction costs. To maintain the existing service, a two-lane bridge would be required near Webb Creek below the present town of Rexford. It would be 2100 feet long and cost more than 4 million dollars. If the dam were located at the lower site, the total Highway 37 cost would be 16.5 million dollars, or more than 3 times as expensive as the same road in the valley bottom. These figures are shown in table 10.

Table 10. Cost of an asphalt highway from Libby bridge to Eureka at present location and along reservoir

	Million dollars
Present location (63.4 miles)	
Existing road	2.5
Improvement	2.0
Replace Rexford bridge	.2
Total	4.7
Location along reservoir (70.7 miles)	
Highway	12.3
Webb Creek bridge	4.2
Total, based on lower dam site	16.5

Relocation of the railroad through the Fisher River area would benefit the logger in that area

The Zone of Influence may be divided into two parts which are quite distinct from the standpoint of the impacts on transportation. They are the Kootenai River subzone and the Fisher River subzone (figure 14).3/

All of the timber now cut in the Fisher River subzone (shaded portion of the map) must be transported to Libby by truck. Trucking costs generally are more or less in proportion to the number of miles traveled. On the other hand, freight charges per mile on the railroad decrease as the length of haul increases. Thus rerouting

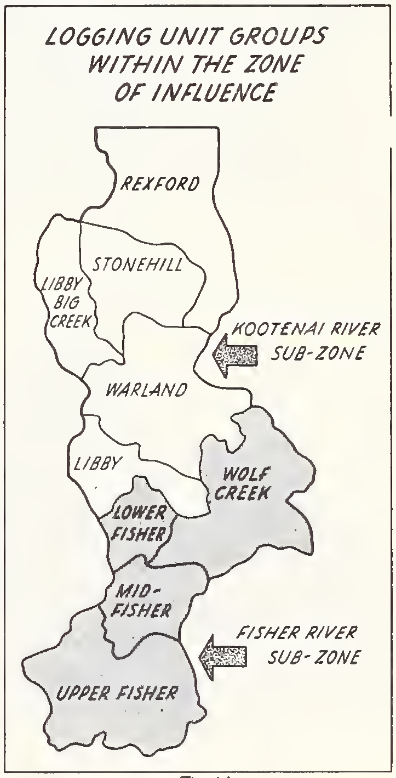


Fig. 14

3/Wood-procurement costs in the Zone of Influence have been calculated for 65 separate logging units which have been combined into the 9 groups also shown in figure 14.

the railroad through the Fisher River subzone offers the opportunity for a worthwhile saving in wood-hauling costs in that area.

Table 11 summarizes these costs as they are now and as they would be with a railroad under one plan of operation. It shows that if the railroad were built, it would be possible to make a net saving of almost one dollar a thousand board feet of sawtimber cut in the area.

Table 11. Effect of railroad on sawlog-procurement costs in the Fisher River subzone

	Present costs	Costs with railroad
	Dollars a thousand bd.ft.	
Road construction[1]	1.86	1.42
Logging	20.44	20.47
Log transportation	8.50	8.04
Total, based on lower dam site	30.80	29.93

[1]/The road construction charges included in sawlog-procurement costs in this and following tables do not include the main roads which would be replaced as part of the dam construction project, but only the additional roads which would be paid for by the timber.

Removal of the railroad from the Kootenai subzone would be a distinct loss to timber utilization in that area

All but a small part of the logs cut in the Kootenai subzone during recent years have gone to Libby for manufacture. Trucks have provided the most economical transportation for the timber in the immediate vicinity of that community, but for the longer distances rail haul has been much cheaper. Thus, removal of the tracks from the Kootenai River subzone is a loss to that area that presently cannot be offset by trucks. Table 12 shows that the total cost of hauling logs from the Warland group of logging units by truck to the rail siding and thence to Libby by train is approximately $7.75 a thousand board feet. If it were necessary to use trucks for the entire distance, the cost would rise by 75 cents. Switching from truck-rail to all truck in the case of the Rexford units would cause the cost to jump $5.18 a thousand board feet. These differences make it desirable to make maximum feasible use of the reservoir itself for wood hauling in order to keep costs down.

Table 12. Cost of transporting logs from the stump to Libby

Logging units	By truck and rail	By truck
	Dollars a thousand bd.ft.	
Warland group	7.75	8.50
Rexford group	9.02	14.20

Basically, water towing is the cheapest method of wood transportation--even cheaper than rail. It could be used to good advantage on the Libby dam reservoir. However, water towing on the reservoir would have certain limitations which would both make it more costly than normal and prevent

it from being the complete solution to the wood-transportation problem. In the first place, the industries now using the bulk of the timber in the Zone of Influence are located in Libby, about 4 miles from probable load-out point of the lower dam site. Thus, any wood boomed and towed on the reservoir must be reloaded onto trucks for the remaining haul. The truck haul alone would add about $1.80 a thousand board feet to the cost of sawlogs. There appears to be no feasible plant location where a rehandling of wood could be avoided.

The extreme variation in the water level is another serious disadvantage from a water haul standpoint. During normal years it is expected the difference between the high and low water marks would be 137 feet. Occasionally the difference would be 176 feet. In our estimation it is not economically practical to use the reservoir for log transportation when the water level is more than 60 feet below the high water mark.

The level of the reservoir would be down more than 60 feet during a large part of every year and would thus be unavailable for log transportation during that period.

Even to operate with a 60-foot drawdown, which is the height of a 6-story building, requires heavy and expensive equipment for putting logs into the reservoir and taking them out again. Figure 15 shows the type of machinery which would be required at the dam site for removing logs. It would cost in the neighborhood of 1/4 million dollars. Smaller devices would be necessary at several locations around the flowage. If the reservoir were depended on entirely for log transportation, 10 such dumping installations would be necessary, which would cost about 1.2 million dollars. Not only would these pieces of equipment be expensive, the annual cost of operating them would be a significant item.

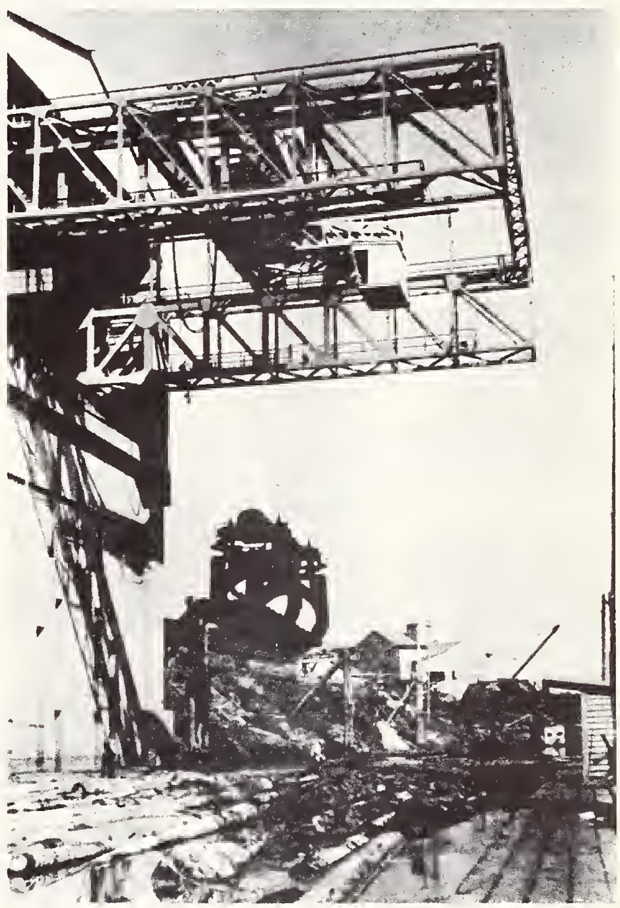


Figure 15. An expensive derrick of the sort shown here would be required near the dam if the reservoir were used for wood hauling to any extent.

Use of the reservoir would be further restricted by icing. Freezing over of bodies of water is related to air temperatures, water depth, and other factors. It is believed that conditions would be such that the Libby dam reservoir would freeze sufficiently during every winter to prevent its use for transportation during that season of the year. The average January temperature, for example, is 22.6 degrees above zero, and the average minimum for that month is 13.5 degrees above zero.

It is expected that the combination of freezing and drawdown would limit use of the reservoir by forest industries to 6½ months a year within the period May to December. Thus, if the reservoir were depended upon to the exclusion of all other methods of log transportation in the Kootenai River subzone, the seasonal operation required would increase the wood-procurement costs (appendix page 169).

Seasonal transportation does not, of course, always require seasonal logging. The historic river drive is the best example of that. The logs are decked along the river banks during the winter and then rolled into the water when the flood stage starts in early spring. However, there are several factors which would make such a practice infeasible in the Kootenai River subzone. Supply of the logging camps would have to be largely by mountain roads which would be extremely difficult and expensive to keep open. Furthermore, there would have to be extra handling of logs at the water's edge in addition to the storage and re-handling at the mills. Movement of the winter logs to the mills could not get underway until late in May, thus adding to the problem of log deterioration. All in all, it would appear completely impractical to log on a year-long basis with seasonal transportation.

Table 13. Comparison of sawlog-transportation costs in Rexford group logging units by cheapest present method and by water

	Rail	Water 1/
	Dollars a thousand bd.ft.	
Stump to water or siding	3.72	4.37
Transfer to water or rail	1.60	.39
Freight to Libby	2.95	-
Switching and unloading	.75	-
Raft and towing	-	1.52
Lift and load trucks	-	.57
Truck, dam to Libby	-	1.80
Maintenance water facilities	-	.70
Cost of water facilities	-	2.57
Extra costs seasonal operation	-	2.78
Total, based on lower dam site	9.02	14.70

1/ Figures relate to lower dam site.

Table 13 shows how the cost of main haul by water would compare with rail so far as the Rexford group logging units are concerned. The cost of actual handling of the logs is less by water but these savings are more than offset by extra costs of water facilities and seasonal operation. The difference shown in table 13 amounts to $5.68 a thousand board feet.

Logs from the Libby group logging units are now trucked to Libby. If principal reliance were placed on water transportation, log-hauling costs would triple, as shown in table 14.

Table 14. Comparison of sawlog-transportation costs in Libby group logging units by cheapest present method and by water[1]

	Truck	Water
	Dollars a thousand bd.ft.	
Stump to Libby	5.06	[2] .67
Stump to water	-	2.30
Transfer to water	-	.31
Raft and towing	-	.17
Lift and load trucks	-	.45
Truck, dam to Libby	-	1.43
Maintenance water facilities	-	.56
Cost of water facilities	-	2.04
Extra logging roads	-	5.47
Extra costs seasonal operation	-	2.20
Total, based on lower dam site	5.06	15.60

1/Figures relate to lower dam site.
2/Some timber not convenient to reservoir would have to be trucked from the stump to the mill.

These data tell us that the reservoir would not provide the whole answer to the wood-transportation problem. If water transportation were depended upon exclusively for removal of timber from the portion of the Kootenai River subzone directly tributary to the reservoir, it would be uneconomical to log most of this area.

Truck transportation, while economical for short distances, is costly for longer hauls. Long distance is no problem for water haul. On the other hand, water costs mount when this method is used to the extent that the logging operation becomes more seasonal. These two factors give us an opportunity for a compromise. By combining trucking and water haul, wood-procurement costs can be kept lower than if either method is depended upon exclusively. Furthermore, they can be kept more or less in line with the costs which would prevail if there were no dam. This is shown in table 15.

Table 15. Kootenai subzone sawlog-procurement costs as influenced by type of mainline transportation[1]

	Dollars a thousand bd.ft.
Present (truck and rail)	31.80
All truck	35.88
Principally water	38.61
Truck and water	33.68

1/Figures relate to lower dam site.

We will show later that by developing a combination of truck and water haul in the Kootenai River subzone and with the economies made possible by the railroad in the Fisher River subzone it is possible to restore transportation facilities in such a way as to have a relatively small, if any, adverse effect on wood-procurement costs in the entire Zone of Influence.

The reservoir will handicap rather than aid the forest administration

Seventy-two percent (557,000 acres) of the forest area lying within the Zone of Influence is federally owned in the Kootenai National Forest. This area is in 4 ranger districts which lie entirely or partially within the Zone of Influence. They are the Rexford, Warland, Libby, and Fisher Districts. The water will drown out the headquarters stations at Rexford and Warland, many miles of telephone line, and certain other administrative facilities. These are, however, relatively simple problems of replacement. Travel and transportation are the main problems to be considered in connection with administration, as they are with wood procurement.

Wood transportation on the reservoir area is mainly upstream or downstream. Much of the administration travel and protection activities, on the other hand, are from one side of the valley to the other. Therefore, the reservoir constitutes more of a barrier to the administrator than to the logger. For some purposes, motor boat travel would be very handy, but if either the starting or stopping point were any distance from the water's edge, such a conveyance would fall short of filling the bill.

Travel facilities are important to any phase of administration, but they are especially so to fire protection. Fire was the first big problem the Forest Service had to cope with when the Kootenai National Forest was created. It still absorbs much of the attention and energy of the Forest Service, particularly during the drier years. Two factors have combined to make the job big:

1. Unlike most regions, most of the fires are lightning caused and tend to be inaccessible. In the 20 years from 1931 through 1950, 82 percent of the fires on the Kootenai National Forest were started by lightning.

2. Many of the fires which occur here have the capacity to grow to catastrophic proportions, in the absence of prompt and adequate fire control efforts.

Parenthetically, we might point out that the wisdom of aggressive fire control in this locality has been amply demonstrated. In 1940, H. T. Gisborne compared the situation on 5 million acres in the Kootenai and Kaniksu National Forests with an adjoining area of similar size in Canada.4/ During the summer of 1940 conditions were conducive to a bad fire situation in both areas. Yet when Gisborne totaled the score on August 20 that year, only 6000 acres had burned in the United States as compared with one-quarter million acres in Canada. Moreover, some of the Canadian fires were still raging out of control when he made his survey. Weather conditions were the same in both areas. The difference in burned acreages reflected entirely the effort that each country was able to direct to fire control, including the better road and trail system on the United States side of the line.

4/ Comparison of intensive versus limited forest fire control action, by H. T. Gisborne, research note 10, Northern Rocky Mountain Forest and Range Experiment Station, Missoula, Montana, September 1940.

In contrast with the general greenness of the Kootenai National Forest today, many thousands of acres directly across the international boundary have been burned and reburned to the point of devastation. Oldtimers tell us that the result of the excessive burning in Canada can be seen in the Kootenai River which is said to carry far more silt today than it did 50 years ago. Fairly large river steamers once plied between Jennings and Fort Steele in Canada. Today, because of channel deterioration, boats of that size can no longer safely travel between these points.

As we have already mentioned, part of the reason fire losses in the Libby-Troy Working Circle have been kept within bounds is that much of the area has been accessible by road. Speed is essential in forest fire control as it is with city firefighting. There needs to be fast detection, fast initial attack, and fast reinforcement. A road system on which cars can move 20 to 50 miles an hour has been a big aid in speeding initial attack and reinforcement.

Expanding use of smokejumpers during the past decade has not eliminated the need for any of the existing roads. Development of the smokejumper organization has been the biggest forward step in fire control in many years, but it is not a cure-all. Smokejumpers cannot jump on rocky ground, nor can they jump where it is steep, nor where there are many snags or mature larch trees. Ordinarily it is not safe for them to jump when the wind exceeds 15 miles an hour. Fires often occur at night and should be attacked before daylight. Smokejumpers could not do that. About 70 percent of the area within the Zone of Influence is suitable for jumper action on small fires in the daytime, providing weather conditions are favorable.

When a fire escapes from the original attacking force it is not ordinarily possible to supply reinforcements by air, thus roads are needed for fast follow-up. Shortage of manpower during the past few years has increased the dependence upon machines, particularly bulldozers. One bulldozer will do the work of 25 to 50 men when it comes to building fire line(figure 16). There is a map in the appendix of this report (figure 59) which shows that bulldozers can be used effectively over a considerable portion of the Zone. The dozers, of course, are to be found where road building or logging is going on. To be of maximum effectiveness they must be moved to the individual fire in a matter of hours.

Water transportation cannot replace roads for firefighting purposes. The fact that a different vehicle is required for movement on water than on land makes the system basically cumbersome, slow, and expensive. Perhaps the most important drawback of water-road transportation of fighters and their gear, however, is the topography. Because of steep slopes there are relatively few places where it would be possible to switch from water to roads with any degree of ease.

Figure 16. In some types of country the bulldozer is the most effective means for quickly surrounding a blaze with a fire line. With present-day shortages of manpower, good fire transportation planning must provide for quick movement of such heavy machinery over much of the forest area.

The seasonal employment which would result from maximum dependence upon water transportation of logs would be a weak spot in the local economy

Marked seasonal variation in employment is a weakness in the economy of any area. Not only is unemployment a blow to the worker and his family, the reverberations echo through the entire community. An added load is dumped on local welfare facilities. People in secondary or service industries find their income affected. Social problems are often generated.

Like most, if not all other states, Montana has a very real problem of seasonal variation in employment. From 1947 through 1952 the average number employed by nonagricultural industries was over 150,000 in the summer months, falling off to 135,000 in January, February, and March (figure 17). This pattern varies little from year to year and is, of course, related to weather. Conditions during the winter and spring months hamper many kinds of operations.

On the whole the lumber industry has one of the poorer records with regard to stability of employment. In some localities deep snows interfere with logging operations. Then later in the spring, when the frost is leaving the ground, most logging operations shut down from 4 to 8 weeks. A recent study of unemployment insurance says: "Because of the concentration of the lumber industry in western Montana, the seasonality of employment creates serious problems in certain areas, particularly in Flathead, Lake, Sanders, and Lincoln Counties, where lumber workers make up a large part of the total employment. Unemployment is severe and benefit payments are heavy in these areas during the winter months."5/

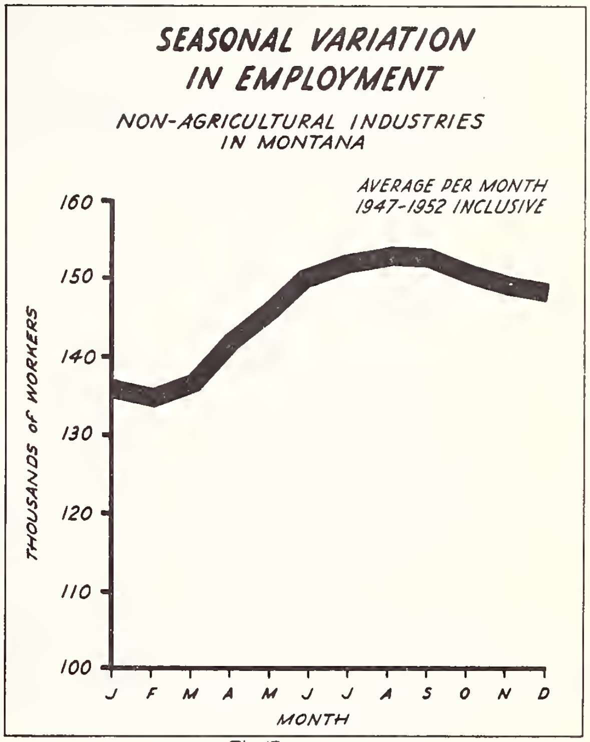


Fig 17

Employment instability has long been recognized as one of the handicaps of the timber producers in this region. We have already pointed out that seasonal logging is more expensive than yearlong operation because of higher wages and lower efficiency. Also a firm with a poor employment record pays almost 3 times as much for unemployment insurance as one with a top rating. Perhaps the worst feature of this type of operation for the employer is that high labor turnover is a direct result of extended idleness. It is impossible to develop and hold together an efficient logging crew with part-time employment.

All of this is significant to the planning for restoration of transportation facilities behind Libby dam, because if the reservoir is used for hauling wood products to the extent possible, logging would become markedly more seasonal and employment more unstable. If all of the wood tributary to the reservoir were moved on it there would be a 40-percent reduction of the January-March logging in the entire Libby-Troy Working Circle if the dam were built at the lower site. Slashing the winter logging operation by 40 percent would have two direct effects on employment (1) more workers would be required to get out the same volume of logs during the shorter season, and (2) the average income per worker would decline.

Logging employees of the J. Neils Lumber Company and the logging contractors of this Company worked an average of 10.7 months in the

5/Unemployment insurance in Montana: Part 1, The Economy of Montana, by Harold J. Hoflich and Maxine Johnson, Montana State University; and Part 2, Benefit Financing, by Unemployment Compensation Commission, Helena.

woods or in work connected with the logging operation during 1952. The average was extended to 10.9 months by employment given some of the loggers in and around the mill during March and April.

Actually, of course, some of the loggers worked more than 10.7 months in the woods and some less. However, for purposes of calculation the average figure can be used. Reducing the winter logging operation by 40 percent or 8 million board feet annually would adversely affect about 310 workers. Instead of working 10.7 months annually, they would have to get along with an average of 7.7 months a year. As shown in table 16, this would reduce the net annual income per worker by $476.

Table 16. Impact of reduced employment upon the annual income of the individual wage earner

	10.7-month year	7.7-month year
	- - Dollars - -	
Gross income	4451	3523
Less income taxes	370	178
Plus unemployment insurance	60	320
Net income	4141	3665

This loss of income per wage earner is one of the important costs of any transportation plan which makes maximum use of the reservoir for wood hauling. It is a cost paid for in a reduced standard of living of the families directly affected.

With the dam at the lower site and with maximum dependence upon water transportation, the total income deficiency to logging workers would probably be about $148,000 annually, a figure obtained by multiplying 310 workers by $476 per worker year.

It may be argued that the income deficiency would actually be less than we have indicated because many of these workers would find supplemental employment elsewhere. Such a view does not seem to be justified because the additional unemployment would occur during a period when the pool of unemployment is already overflowing. Thus, any work obtained by loggers outside of the industry at that time would not really reduce the income deficiency. The load would merely be transferred to other shoulders.

UPSTREAM FACILITIES REQUIRED FOR THE LOWER DAM SITE, RIVER MILE 204.9

The question to be answered is, what restoration of transportation and other facilities behind the dam is in the public interest, taking into account original construction costs and subsequent costs of management and utilizing the local timber resource? Since the roads used for wood hauling and administrative travel also serve other industries, recreationists, and general public travel, the decision as to which system is most desirable must take account of more than forestry factors. In the following analysis 5 annual costs are considered in addition to the original capital investment. They are wood procurement, national forest administration, seasonal unemployment in logging, highway maintenance, and nonforestry traffic.

The existing facilities listed below will be entirely or partially submerged by the reservoir if the dam is located at the lower site:

1. The Great Northern Railway which follows the Kootenai River from the vicinity of Rexford to Libby.
2. State Highway 37 which parallels the railroad between these two points. The highway crosses the river at Rexford. There are both a heavy-duty logging bridge and a public travel bridge at this point. A heavy-duty bridge at Warland connects the highway with the railroad. Highway 37 is not at present adequate for the service it is expected to eventually render. A 46-mile stretch needs to be widened, straightened, and surfaced with a standard asphalt mat. The highway bridge at Rexford is substandard and should be replaced. The total cost of the bridge and of improving the highway to a satisfactory standard will amount to about 2.2 million dollars.
3. A heavy-duty logging road extending from Libby up the east side of the Kootenai River, thence up Fisher River to the mouth of Wolf Creek, thence up Wolf Creek several miles. This road, built by the J. Neils Lumber Company is now about 41 miles long. Further extensions of the road up both the Fisher River and Wolf Creek are contemplated.
4. Two heavy-duty secondary roads on the east side of the Fisher River and the Kootenai River feeding into the main Fisher River road, and the Great Northern Railway.
5. National forest administration facilities lying in 4 ranger districts (Warland, Rexford, Libby, Fisher). The headquarters stations of the Warland and Rexford districts lie in the proposed flowage area as do a number of miles of metallic and grounded circuit telephone lines connecting these stations with their fire control lookouts and work camps.

The existing transportation system and the costs of operating with it are analyzed in Study 0.

Three restoration plans are analyzed in this chapter. They are called Studies 1, 2, and 3. All 3 plans contemplate the same rerouting of the mainline of the Great Northern Railway between Stryker and Libby; i.e.,

along Fortine and Wolf Creeks to the Fisher River, up the Fisher River to US Highway 2, and along the highway to Libby. The plans differ as to degree of dependency upon water transportation, the route of Montana Highway 37, location of other roads, and restoration of administrative facilities. The present road system and the proposed system for each study are shown in figure 18.

<u>Study 1 is aimed at reducing the original investment by depending upon the reservoir for wood transportation wherever it will serve that purpose</u>

This plan proposes relocating Highway 37 away from the reservoir on a route crossing the Flathead Mountains. Starting from US Highway 2, 4 miles south of Libby, 71.6 miles of highway would be constructed extending along the east side of the reservoir beyond the present town of Warland, thence up Five Mile Creek and northeast to US Highway 93, 14.9 miles southeast of Eureka. The entire 71.6 miles would have a 24-foot-wide asphalt surface. This route, by avoiding the heavy construction along the face of the reservoir, is probably the cheapest postdam highway route between Libby and Eureka. However, the highway distance between Libby and Eureka would be increased from the present 63.4 miles to 90.5 miles.

Practically all of the wood in the Kootenai subzone--equal to more than half of the cut in the entire Zone of Influence--would be transported by water. Despite this dependence upon the reservoir for wood haul, 135 miles of roads (in addition to the highway) would be required for fire protection and administration. This is actually more road than in the other 2 studies, but the economy would come from the fact that these roads could be of low standard along the ridge tops.

Use of the reservoir for wood hauling would require the installation of 10 log dumps at strategic locations on the water's edge and liftout facilities on or near the dam. The travel limitations imposed by this plan would require the building of a new ranger station in addition to replacing the two flooded out.

<u>Study 2 is aimed at developing a low-cost road system which would be partly usable for wood transportation, thus avoiding the seasonal operation necessary in the Kootenai subzone in Study 1</u>

This plan proposes the same location of Highway 37 as in Study 1; that is, across the Flathead Mountains via Five Mile Creek. However, in this case the 32 miles of highway from US Highway 2 north would have a 28-foot-wide asphalt surface instead of a 24-foot surface to accommodate off-the-highway trucks on that section of the road. 6/

Study 2 proposes constructing 113 miles of other road, 22 miles less than in Study 1. These roads would be of higher standard than the Study 1 roads and located near the reservoir where they would serve for log transportation. They would also serve better for fire protection than the Study 1 roads because they would tie in well with roads up the individual drainages, thus involving shorter travel distances. About one-third of

6/ Such trucks are heavier and wider than now permitted on the highways.

PRESENT PRINCIPAL TRANSPORTATION ARTERIES IN ZONE OF INFLUENCE AND THREE RELOCATION ALTERNATIVES – Dam site 204.9

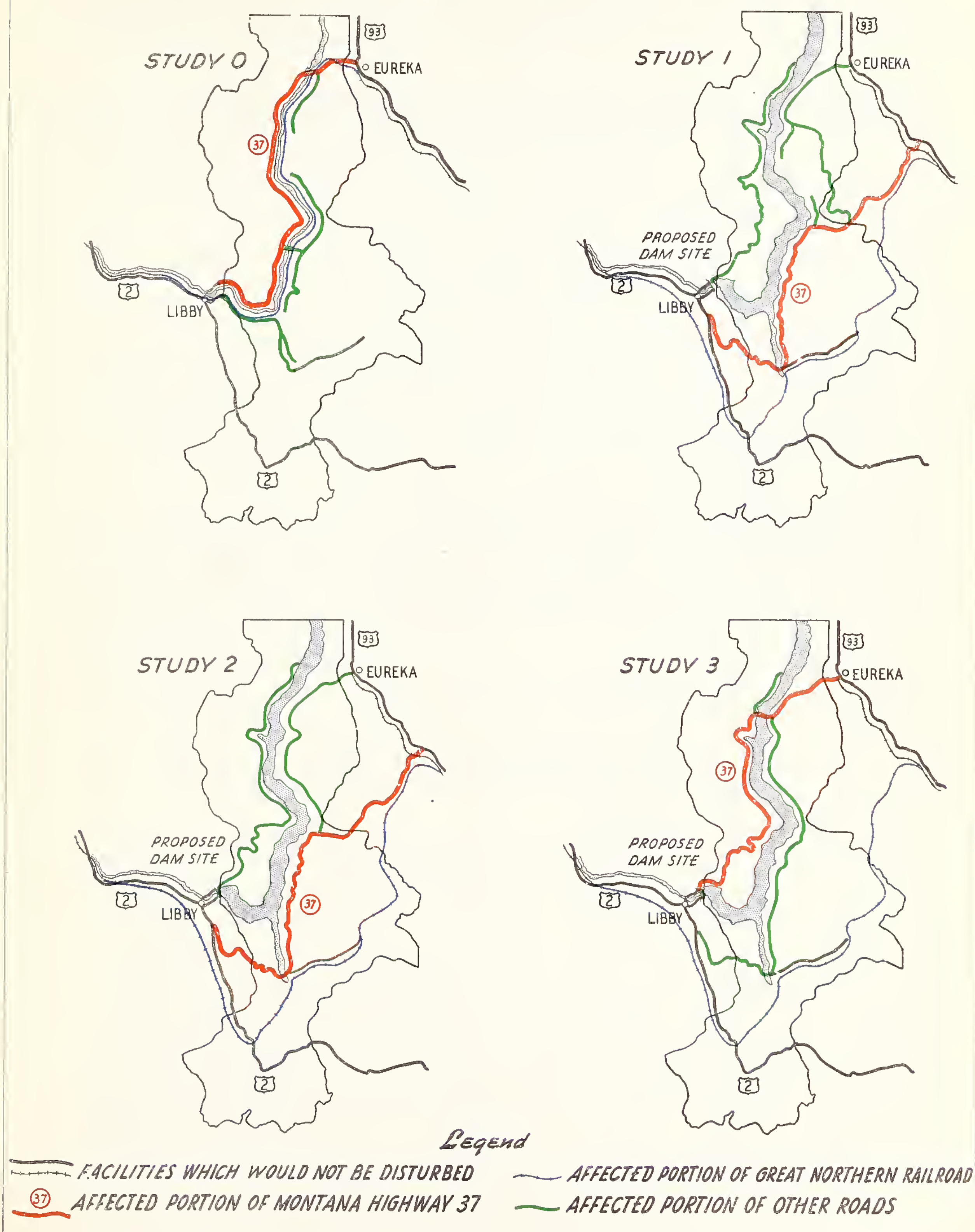


Fig. 18

the log production in the Zone of Influence would be transported by water. Thus, a lift-out facility would be required near the dam. Though the transportation system would be more efficient than in Study 1, an additional ranger station would still be necessary to handle the national forest administration in the Zone of Influence.

Study 3 is aimed at providing a transportation system which would serve as efficiently for all kinds of travel as the transportation facilities which would be developed in the absence of a dam

This plan would consolidate the transportation facilities required for all kinds of travel, a purpose which would be accomplished by locating the highway along the west side of the reservoir. It would cross the reservoir on a long bridge about 7 miles south of the present town of Rexford and then go in more or less of a straight line to Eureka. A total of 70.7 miles of highway would be constructed in this case, about 1 mile less than in Studies 1 and 2. However, the total travel distance between Libby and Eureka would be 19 miles shorter by this route than by the route crossing the Flathead Mountains. The 29.5 miles of this construction nearest Libby and 14.2 miles between the reservoir bridge and Eureka would have a 28-foot asphalt surface, the rest a 24-foot asphalt surface.

The greater utility of this highway location would be reflected in the need for less other road. Altogether only 88 miles would be required or 35 percent less than in Study 1. With this road network it would not be necessary to build an additional ranger station, but only to replace the two inundated. As with Study 2, about one-third of the logs in the Zone of Influence would be hauled by water. The same water facilities would be required as in Study 2.

Table 17 presents some salient statistics comparing Studies 1, 2, and 3.

Table 17. Salient statistics for Studies 1, 2, and 3

	Study 1	Study 2	Study 3
Highway reconstruction--miles	71.6	71.6	70.7
Highway distance Libby to Eureka--miles	90.5	90.5	71.4
Other roads--miles	135	113	88
Log dump facilities on reservoir--number	10	8	8
Annual water haul of sawlogs--million board feet	30.5	19.2	19.2
Annual water haul of cordwood--thousand cords	46.5	30.9	30.4
Required ranger stations--number	3	3	2
Trails--miles	53	30	30
Telephone line--miles	202	202	145.5

Study 1 calls for the least expenditure for restoring the services disrupted by a dam at the lower site

Table 18 shows that because of economy in road construction the original investment in Study 1 would be about one-tenth less than in Study 2 and one-third less than Study 3. The actual figures for Studies 1, 2, and 3 are: $14,679,000; $16,018,000; and $21,347,000, respectively.

Table 18. Cost of replacing facilities

	Study 1	Study 2	Study 3
	- --Thousand dollars-- -		
Roads and trails	14,727	16,971	22,783
Landing field	209	209	209
Communications	377	377	315
Ranger stations	403	403	275
Ferry	100	100	-
Wood-handling facilities on reservoir 1/	1,575	670	477
Recreational facilities	40	40	40
Total	17,431	18,770	24,099
Cost of bringing highway and other valley bottom roads up to satisfactory standard in the absence of a dam	2,752	2,752	2,752
Net cost	14,679	16,018	21,347

1/ In Study 1 all of the wood-handling facilities would be paid for as part of the construction project. In the other two studies it has been assumed that some of the cost could be borne by the wood procurement. These costs are not included here.

Study 1 falls so far short of restoring the services above the lower dam site as to be completely unacceptable

The transportation plan suggested in Study 1 would raise the operating costs all along the line (table 19). Travel difficulties would increase the cost of national forest administration and protection about $39,000 annually over what they would be with the Study 0 system.7/

Table 19. Increase or decrease in annual operating cost in relation to present facilities

	Study 1	Study 2	Study 3
	- - - - -Dollars- - - - -		
National forest administration except fire control and travel	12,200	12,200	-
Fire control except travel	15,700	15,700	2,000
National forest travel	11,100	8,300	-
Wood procurement	186,300	-12,400	-37,400
Highway maintenance	4,100	5,200	14,100
Worker income deficiency	148,000	-	-
Ferry operation and maintenance	7,800	7,800	-
Nonforestry traffic	133,000	133,000	73,400
Total	518,200	169,800	52,100

7/ The annual operating costs are the difference between the costs if there were no dam (Study 0) and the costs with the facilities indicated in each study.

Wood-procurement costs would increase $186,000 annually. The much longer route between Libby and Eureka would increase the cost of nonforestry traffic about $133,000. Not the least of the impacts would be the annual deficiency in worker income of $148,000. This means the economy of the area would have to carry an extra cost of about $518,000 a year.

The Study 3 plan is more desirable than the Study 2 plan so far as the local economy is concerned

The transportation plan of Study 2 is considerably better than the one discussed above both from the standpoint of the timber industry and its workers. However, Study 2 is no better than Study 1 from the standpoint of national forest administration and public travel. The total annual increase in all costs under this plan would be $170,000 greater than Study 0.

The Study 3 plan is best of all so far as annual operating costs are concerned. Wood procurement would be $37,000 cheaper than with the Study 0 transportation. The only annual operating cost which would be higher for Study 3 than in Studies 1 and 2 would be highway maintenance. This is because of the bridge across the reservoir. The total additional operating cost under Study 3 would be $52,000 annually as table 19 shows.

When all factors are considered, Study 3 appears to offer the most desirable solution for replacing facilities behind the dam site at River Mile 204.9

The Study 2 plan and the Study 3 plan each has its advantages. The former involves a lower initial investment by the Army Engineers, but the Study 3 plan would have a considerably smaller adverse impact upon the local economy. Table 20 summarizes all of the measurable costs of the three plans on an annual basis.8/ The difference between the total annual cost of Studies 2 and 3 is so

Table 20. Total annual cost of three alternatives for restoring facilities behind the dam site 204.9

	Study 1	Study 2	Study 3
		Dollars	
Initial cost of facilities	429,100	436,900	559,300
Increase in annual operating cost above present	518,200	169,800	52,100
Total	947,300	606,700	611,400

8/ In reducing the initial capital investment which would be necessary under each plan to an annual basis, the following depreciation periods were used: roads, trails, landing fields--permanent; communication facilities, recreational facilities, and ferry--25 years; ranger stations, work camps, and load-out facilities--33-1/3 years. Bureau of the Budget Circular A-47, of December 31, 1952, sets a maximum amortization period of 50 years for cost-benefit comparisons. However, the road maintenance allowance in the calculations of this analysis is sufficient to permanently maintain the roads in their original condition. Thus, the residual value of the roads at the end of the 50-year period would virtually be the same as their original value.

small as not to be significant. The choice between the two rests on other factors than total measurable cost.

In Study 2, 28 percent of the total annual cost shown in table 20 is impact cost. The other 72 percent would be in original installation of facilities. In Study 3 the impact on the local economy would constitute only 9 percent of the total annual cost. This may be regarded as a distinct advantage of that plan.

The bridge across the reservoir in Study 3 has advantages not apparent in the dollar figures. Without it, the 25 or so families in the Tooley Lake area in the northwest corner of the Zone of Influence would have a long drive to the nearest community (Libby) in the winter and occasionally they would be isolated. During the summer months, these families could cross the reservoir by ferry to get to Eureka.

The bridge would greatly increase the flexibility of the transportation system. It would, for example, make it possible to move timber from the west side of the reservoir to the railroad at Eureka whenever desirable. That is important because sometime in the future water transportation may become less feasible than now. The old-growth timber which will be cut for many years floats reasonably well when adequate precautions are taken. This applies not only to large timber but also to most of the small timber which is fairly old despite its size. As the virgin stands disappear and the cut consists of younger trees with a higher percentage of sapwood, the problem of floating will develop, particularly with ponderosa pine, larch, and lodgepole pine. At that time it may be necessary to lean more heavily on truck and rail transportation in the Kootenai subzone. In this event, a bridge would be essential.

The most compelling argument for the bridge is that it would reduce the "conflagration potential." The fire protection estimates of Study 2 include an additional annual cost because of less favorable transportation. This additional expenditure would provide a comparable degree of safety to Study 3 under normal conditions. However, big fire losses and costly firefighting occur when conditions are very abnormal. At such times the availability of a bridge for the rapid movement of men and machinery may result in a big reduction of the cost and damage of fires in the upper part of the Kootenai subzone.

In the event a dam of the size considered is built at River Mile 204.9, we recommend that the restoration of transportation facilities and those related to forest development and management follow the general pattern presented in Study 3. So far as costs which can be measured in dollars are concerned it is but little more expensive than Study 2. A smaller portion of these costs is in the form of adverse impacts upon the functioning and operation of the local economy. Furthermore, the bridge in that plan offers additional benefits and safeguards not included in the dollar calculations. All these factors appear to make Study 3 the desirable solution to the problems created by a dam at the lower site.

UPSTREAM FACILITIES REQUIRED FOR THE UPPER DAM SITE, RIVER MILE 217.0

From some points of view the dam site at River Mile 217.0 would have a big advantage over the lower site. A dam at River Mile 204.9 would back water some 10 miles up the Fisher River. Being above the mouth of the Fisher River, the upper dam would not, of course, affect the flow of that river. This is an important difference so far as transportation is concerned for with the upper dam the existing Fisher River logging road of the J. Neils Lumber Company would still be usable. Relocation of the mainline of the Great Northern Railway would be less of a problem. It would not be necessary to swing State Highway 37 way south between Fisher River and Libby. However, the upper dam, like the lower one, would completely disrupt transportation in the main Kootenai valley. Likewise, the new location of the railroad would benefit log transportation in the Fisher River drainage.

Following are the existing facilities which would be entirely or partially submerged by the reservoir if the dam were located at the upper site:

1. The Great Northern Railway which follows the Kootenai River from the vicinity of Rexford to the mouth of Fisher River.

2. State Highway 37 which parallels the railroad between these two points. The highway crosses the river at Rexford. Both a heavy-duty logging bridge and a public travel bridge are located at this point. A heavy-duty bridge at Warland connects the highway with the railroad. Another bridge is planned at Stonehill.

3. A heavy-duty secondary road on the east side of the Kootenai River feeding into rail sidings on the Great Northern Railway.

4. National forest administration facilities lying in the Warland and Rexford Ranger Districts. The headquarters stations of these districts lie in the proposed flowage area as do a number of miles of metallic and grounded circuit telephone lines connecting these stations with their fire control lookouts and work centers.

Two restoration plans are analyzed in this chapter. They are called Studies 4 and 5. Both involve the rerouting of the mainline of the Great Northern Railway between Stryker and Libby which is a different routing than for Studies 1, 2, and 3. From Stryker the railroad would follow along Fortine and Wolf Creeks to Fisher River and down Fisher River to Kootenai River, connecting with the present track of the railroad. Both plans depend to the same degree upon water transportation. However, they involve different locations of Highway 37 and other roads as shown in figure 19. The restoration of other facilities would likewise differ.

Study 4 resembles Study 2 for the lower dam site in that it provides a low-cost road system which would permit yearlong operation

State Highway 37 would be routed from a west-side connection with the existing highway. It would cross the dam, then as in Studies 1 and 2 it would follow along the eastside of the reservoir beyond the present town of Warland, thence up Five Mile Creek and northeast to US Highway 93, 14.9 miles south of Eureka. Seventeen and seven-tenths miles on the south end of this highway would have a 28-foot-wide asphalt surface. The rest would have a 24-foot asphalt surface. The virtue of this plan is (1) it involves the smallest possible amount of reconstruction of Highway 37 and (2) it is the shortest route between Libby and Eureka. By eliminating the big loop in Highway 37 south to Wolf Creek, which would be necessary in Studies 1 and 2, the new highway construction would be reduced from 71.6 miles to 42.3 miles. The total highway mileage between Libby and Eureka would be 6.5 miles longer than the present water grade route.

Study 4 would require the construction of 90 miles of other roads for both administrative and log haul purposes. These roads would play a bigger part in the log haul picture than the roads in the counterpart plan for the lower dam site. The reason for this is that the reservoir behind the upper dam would not be as usable for wood transportation as the reservoir behind the lower dam. In the first place, the average hauling distance on the water would be shorter. In the second place, the truck haul from the loading out point to Libby would be 16 miles instead of 4 miles. Both factors would reduce the utility of the reservoir for wood transportation. Less than one-fifth of the timber in the Zone of Influence would be hauled by water.

Five log dumps would be required on the reservoir in addition to the lift-out facilities near the dam.

Study 5 resembles Study 3 for the lower dam site in providing a consolidated transportation plan designed around a reservoir road and a bridge across the reservoir

As in Study 3, Highway 37 would go along the westside of the reservoir, crossing it on a long bridge about 7 miles south of the present town of Rexford, then heading in more or less of a straight line to Eureka. Fifty-seven and six-tenths miles of highway would be built, approximately 15 miles more than in Study 4.

An advantage of this highway location is the need for fewer other roads. This study calls for the construction of 48.7 miles of other road, a little more than half the mileage required in Study 4. The highway distance between Libby and Eureka would be 70.3 miles, 7 miles more than at present and about the same as for the Study 4 route. The reservoir would be used for water transportation of timber to the same extent as in Study 4; that is, somewhat less than one-fifth of the timber would be hauled by water.

Five log dumps would be required on the reservoir in addition to the lift-out facilities near the dam.

PRESENT PRINCIPAL TRANSPORTATION ARTERIES IN ZONE OF INFLUENCE AND THREE RELOCATION ALTERNATIVES – Dam site 217.0

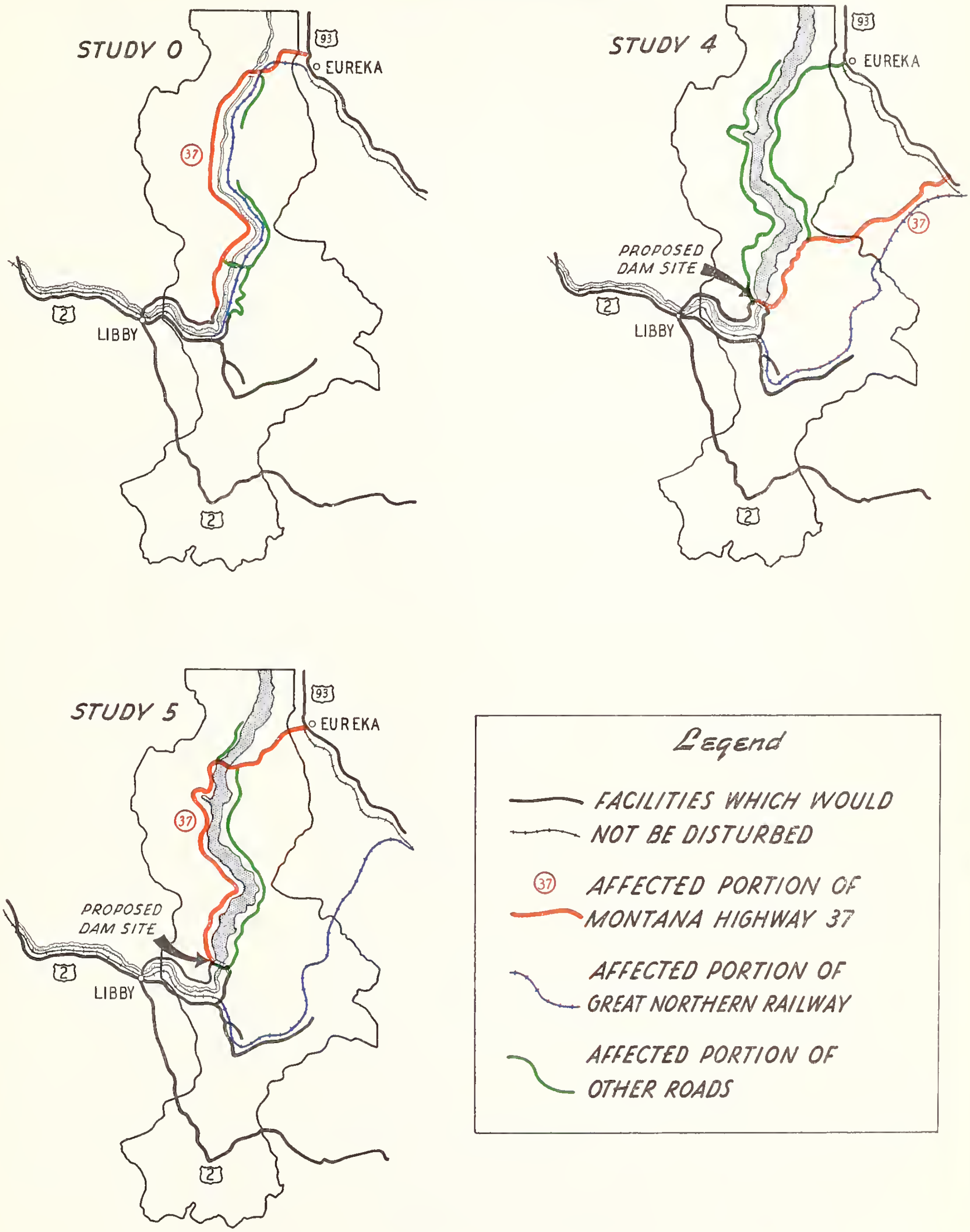


Fig. 19

Table 21 presents some salient statistics comparing Studies 4 and 5.

Table 21. Salient statistics for Studies 4 and 5

	Study 4	Study 5
Highway reconstruction--miles	42.3	57.6
Highway distance, Libby to Eureka--miles	69.9	70.3
Other roads--miles	90	48.7
Log dump facilities on reservoir--number	5	5
Annual water haul of sawlogs--million board feet	11.2	11.2
Annual water haul of cordwood--thousand cords	16.2	16.2
Required ranger stations--number	3	2
Trails--miles	0	0
Telephone line--miles	179	154

The Study 4 plan would require a substantially smaller initial investment than the Study 5 plan

Table 22 indicates that the roads and other facilities called for in Study 4 would cost slightly more than 12 million dollars. The investment necessary in Study 5 is almost 18 million dollars. A big part of this difference is in State Highway 37. Fewer miles of highway would have to be constructed in Study 4 and it would cost only $94,000 a mile. The heavy rockwork along the reservoir and the bridge across the reservoir would bring the average cost of constructing the 57.6 miles of Highway 37 in Study 5 to $274,000 a mile. Study 5 requires less of an expenditure for other roads, but even so the total road construction of Study 4 would be 6 million dollars lower.

Table 22. Cost of replacing facilities

	Study 4	Study 5
	Thousand dollars	
Roads	13,611	19,551
Communications	257	250
Ranger stations	403	275
Ferry	100	-
Wood-handling facilities[1] on reservoir	670	477
Recreational facilities	40	40
Total	15,081	20,593
Cost of bringing highway and other valley bottom roads up to a satisfactory standard in the absence of a dam	2,631	2,631
Net cost	12,450	17,962

1/ In both of these studies part of the cost of wood-handling facilities is charged to the logging operation and is not, therefore, included in this table.

The Study 4 plan would also have a smaller total impact on annual travel costs etc.

Actually the transportation plan of Study 5 would be better suited to the needs of timber utilization and national forest administration and protection. However, these advantages are more than offset by the economies of public travel and highway maintenance in Study 4. Selection of the Study 4 plan would increase annual operating costs $23,300 (over Study 0), as compared to $102,100 with the Study 5 plan. Table 23 compares these annual operating costs.

Table 23. Increase or decrease in annual operating cost in relation to present facilities

	Study 4	Study 5
	- - - Dollars - - -	
National forest administration except fire control and travel	12,200	-
Fire control except travel	16,000	2,000
National forest travel	6,400	-
Wood procurement	48,100	31,400
Highway maintenance	-11,200	5,400
Ferry maintenance and operation	7,800	-
Nonforestry traffic	-56,000	63,300
Total	23,300	102,100

Therefore, so far as measurable factors are concerned, the Study 4 plan is clearly superior to Study 5

Table 24 compares the overall costs of each study. In this table the project costs of restoring facilities are converted to an annual basis and added to the annual operating costs. The total annual dollar cost of the Study 4 plan would be $367,700 or 36 percent less than the Study 5 total cost of $575,000.

Table 24. Total annual cost of two alternatives for restoring facilities behind the Dam Site 217.0

	Study 4	Study 5
	- - - Dollars - - -	
Initial cost of facilities a year	344,400	472,900
Increase in annual operating cost above present	23,300	102,100
Total	367,700	575,000

Study 4 does, however, have some important limitations

The bridge across the reservoir proposed in Study 5 would be a real asset for the same reasons it would in Study 3. It would be a desirable link between the Tooley Lake families and the outside world. It would considerably increase the flexibility of transportation and would encourage rather than hinder development of the northern portion of the county. Timber utilization would not be hamstrung in some of the logging units if and when water transportation becomes less feasible. The "conflagration potential" of forest fires in the north end of the Zone of Influence would be lowered.

The situation created by the Libby dam reservoir would in some respects be unique. As the lake would extend a long way across the international border, there would be no way around it on the north so far as people in this area are concerned. Therefore, there is justification for misgivings about accepting any solution which does not provide a yearlong heavy-duty crossing of this 53-mile-long lake. A ferry does not meet these qualifications. For these reasons the Study 4 plan, despite its economies, does not appear the complete answer to the transportation problem created by a dam at River Mile 217.0. On the other hand, the relatively much higher costs of the Study 5 plan would be against it.

The most equitable solution for Dam Site 217.0 appears to be the road plan of Study 4 with the bridge of Study 5

Such a plan would require an initial project investment of 16 million dollars (table 25) or 2 million dollars less than Study 5, and 4 million dollars more than Study 4. A transportation plan of this sort would mean that as in Study 5 no additional ranger station would be required. The same communications restoration would be required as in Study 5. The compromise would include the best features of each transportation plan and, therefore, would have a minimum impact upon the local economy.

Table 25. Cost of replacing facilities

	Compromise Studies 4 and 5 Thousand dollars
Roads	13,611
Bridge	4,180
Communications	250
Ranger stations	275
Wood-handling facilities on reservoir	477
Recreational facilities	40
Total	18,833
Cost of bringing highway and other valley bottom roads up to a satisfactory standard in absence of a dam	2,631
Net cost	16,202

Table 26 shows the increase in annual operating costs over Study 0 and the annual cost of the original investment. The total dollar cost of the compromise plan would be $432,800 or $65,100 a year more than the Study 4 plan. This seems the most equitable solution to the restoration problem of Dam Site 217.0. Inasmuch as the bridge across the reservoir would not be on a state highway, maintenance of this bridge could not be paid for out of state highway funds. Financing this maintenance would, therefore, be a problem.

Table 26. Total annual cost of compromise plan for restoring facilities behind Dam Site 217.0

	Dollars
National forest administration except fire control and travel	-
Fire control except travel	2,000
National forest travel	-
Wood procurement	48,100
Highway maintenance	-11,200
Bridge maintenance	21,000
Nonforestry traffic	-56,000
Subtotal	3,900
Initial cost of facilities a year	428,900
Total annual	432,800

MAJOR FEATURES OF RECOMMENDED ROAD PLANS

In recommending the Study 3 plan for Dam Site 204.9 and a compromise plan for Dam Site 217.0, we have chosen two substantially different solutions. A look at table 27, which summarizes the original investment costs of all the plans, shows that three-fourths of the total cost in Study 3 is the reconstruction of Highway 37. On the other hand the recommended plan for Dam Site 217.0, almost three-fourths of the total cost, is for other roads. In both cases, of course, the reservoir bridge is a big item. The reason these solutions differ is that the upper dam site, unlike the lower one, does not involve the Fisher River drainage and does not have to contend with the problems a backwater up the Fisher River would create.

The recommended plan for the lower dam site is built around State Highway 37. In addition to providing a through route from Libby to Eureka this highway, because of its location along the west side of the reservoir, would have considerable recreational traffic. It would also be a main travel route for logging trucks. From Libby to a point near Bristow Creek and from the bridge to Eureka a 28-foot-wide surface is planned to safely accommodate all of this traffic. The rest of the highway is planned for 24-foot width because the heavy logging operation in that locality would occur during the winter when other travel is at a minimum.

The road from US Highway 2 to the southern tip of the reservoir at Wolf Creek would also be a principal artery. A large volume of timber would be moved over this route, both summer and winter. A ranger station would be located at Wolf Creek. Thus, to accommodate logging, administrative, and public travel a 24-foot road is recommended. The other roads in the Study 3 plan would be 12 and 16 feet wide.

The compromise plan recommended for the upper dam site would route Highway 37 across the dam and up Five Mile Creek to Stryker. From the dam to the mouth of Five Mile Creek, it would have a 28-foot surface to accommodate heavy logging, administrative, recreational, and public travel. From the mouth of Five Mile Creek to its junction with US Highway 93 at Stryker, it would be 24 feet wide. A 12-foot road with turnouts would be built along the east side of the reservoir from the mouth of Five Mile Creek to the reservoir bridge, and a 16-foot road from the reservoir bridge to Eureka. Public traffic over the 12-foot section would be light and the logging trucks would travel only short distances on it to the log dumps along the reservoir. The total traffic load from the bridge to Eureka likewise would not be heavy.

A road is recommended along the westside of the reservoir. Though not a state highway it would still be a key transportation link. Since the new ranger stations would be at Libby and Eureka, there would be much administrative travel over this road. Recreationists would use it and there would be considerable logging traffic. From Libby to Bristow Creek, a 24-foot surface would be necessary. A 16-foot road with turnouts is planned from Bristow Creek to the west end of the reservoir bridge and beyond it 7.5 miles up the west side of the reservoir. The

principal logging traffic on this section would be in the winter, and therefore would not conflict materially with recreational traffic.

In Study 3, $2,752,000 is deducted from the construction cost, and in the compromise plan $2,631,000 is deducted. (The difference between the two figures is explained later.) The deduction in each case is the estimated cost of completing and perfecting the mainline transportation system if there were no dam. These costs which would be incurred anyway cannot fairly be charged to the dam project. However, building the dam precipitates the problem of financing these costs. If no dam were built the existing roads would be extended and improved over a period of years without any difficulty. With a major road reconstruction project by the Corps of Engineers it would undoubtedly be necessary to spend the $2,752,000 (or$2,631,000) to complete these roads to their ultimate standard in a shorter period than would otherwise be the case. Inasmuch as the larger percentage of the area in this locality is national forest, part of the reconstruction cost not chargeable to the dam would still have to be paid by the federal government. Therefore, it would appear good business to appropriate the federal share of the $2,752,000 at the same time the money for the dam and the facilities chargeable to the dam is appropriated.

Maintenance of a bridge across the reservoir is another problem. In the recommended plan for Dam Site 204.9, it would be on State Highway 37. In the plan for Dam Site 217.0, it would be on the national forest road system. An annual maintenance bill of $21,000 for this bridge would be a burden on either the State Highway Department or the Forest Service. We recommend that like the load-out crane at the lower end of the reservoir and the roadway across the dam, this bridge be considered a facility of the dam and maintained by the agency operating the dam.

Table 27. Cost of restoring facilities related to forestry and forest development in Zone of Influence of Libby dam, including only facilities which should be charged to dam building project

Item	Dam at River Mile 204.9			Dam at River Mile 217.0		
	Study 1	Study 2	Study 3	Study 4	Study 5	Compromise plan
	Dollars					
Highway 37	6,508,076	7,107,323	16,522,467	3,990,124	15,808,650	3,990,124
All other roads	8,102,414	9,797,626	6,194,799	9,620,557	3,742,169	13,800,557
Trails	116,600	66,000	66,000	-	-	-
Landing field (Libby)	209,330	209,330	209,330	-	-	-
Communications	377,170	377,170	315,160	257,295	249,735	249,735
Warland and Rexford ranger stations and work camps	274,694	274,694	274,694	274,694	274,694	274,694
Additional ranger station	128,041	128,041	-	128,041	-	-
Log dumping and load-out facilities	1,450,000	630,000	440,000	630,000	440,000	440,000
Equipment for water transport	125,000	40,000	37,000	40,000	37,000	37,000
Recreational facilities	40,000	40,000	40,000	40,000	40,000	40,000
Ferry	100,000	100,000	-	100,000	-	-
Total	17,431,325	18,770,184	24,099,450	15,080,711	20,592,248	18,832,110
Cost to complete existing main roads in absence of dam	2,752,500	2,752,500	2,752,500	2,631,300	2,631,300	2,631,300
Net cost to project	14,678,825	16,017,684	21,346,950	12,449,411	17,960,948	16,200,810

APPENDIX A. BACKGROUND OF THE LIBBY DAM PROJECT

On May 17, 1950 the Congress, under the Rivers and Harbors Act, authorized construction of the Libby dam as a Corps of Engineers project. Long before this time, the authorization had been anticipated. The Regional Forester, U.S.Forest Service, Region 1, Missoula, Montana, received notice on March 24, 1947 that a public hearing would be held at Libby, Montana on April 17. The hearing was held on that date; a second hearing was held at Libby on July 7, 1948; and a third at Bonners Ferry, Idaho on July 27, 1948. Proceedings of these hearings are of record.

The Regional Forester, on May 24, 1949, addressed a letter to Colonel Hewitt, Chief, Corps of Engineers, Seattle, regarding the problems arising from the dam installation as they would affect national forest administration and resources. He submitted a preliminary estimate indicating roughly the job of restoration of services that would result by reason of disarrangement of present facilities through creation of the lake behind the proposed Libby dam. On June 7, Colonel Hewitt replied, stating the Region's preliminary report would be useful in the planning work of the Corps and the Forest Service when the project was authorized.

The Secretary of Agriculture addressed a letter dated June 23, 1949 to General Pick, Chief, Army Engineer Corps, Washington, D. C. He cited the report "Columbia River and Tributaries," by the Corps and recommended that legislative authorization be sought for restoring the service facilities required for administering and managing the national forest. General Pick replied to the Secretary on June 28, 1949. He agreed with the Secretary's letter and promised to testify to the need for such action.

Colonel Itschner, Corps Chief, Seattle, addressed a letter to the Regional Forester on February 17, 1950, requesting a meeting at Missoula to discuss the restoration program set forth in the Regional Forester's letter of May 24, 1949, to Colonel Hewitt. The meeting was held March 21 and 22, 1950.

Mr. Culbertson of the Corps staff, Seattle, was detailed to Missoula and Libby during January 1951. His job was to discuss the problems, to go over them on the ground, and to acquire preliminary facts relative to impact of the dam construction upon the Kootenai National Forest. This work was preparatory to arranging a working agreement wherein the actual planning work might be done by the Forest Service under a cooperative agreement financed by the Corps.

These preliminaries bore fruit in January 1952 when the Libby dam study reported on here was begun. The project, in the main, has been financed by the Corps of Engineers from its planning funds. However, the engineering, logging, and economic analyses have been made by the Forest Service. The conclusions presented here represent the Forest Service's opinion of the action justified in minimizing the impact of a large dam which might be constructed near either River Mile 204.9 or River Mile 217.0

Ernest Grambo, staff assistant on the Kootenai National Forest, was assigned the job of starting the planning study. He was assisted by several men of the Kootenai National Forest staff and arranged with the J. Neils Lumber Company to get necessary information on its timberland

holdings within the area to be affected by dam construction. The work supervised by Granbo consisted of compiling statistical information, timber estimates, and maps which were of material value to the study.

On April 22, 1952, C. S. Webb was assigned to the Libby dam study as project leader. In the subsequent work he has been assisted by Ward W. Gano, civil engineer; Paul H. Logan, logging engineer; and S. Blair Hutchison, forest economist. In addition to supervising the project, Webb has analyzed national forest administration costs. Details of his analyses are contained Appendices E and H.

Gano has been largely responsible for the transportation planning phases of the project. The details of his findings are reported in Appendices C and F. As logging engineer, Logan has been responsible for determining prospective wood-procurement costs under each of the transportation plans. These estimates are documented in Appendices D and G. The economics phases of the analyses have been handled by Hutchison, who has also collaborated with Webb in preparation of the body of this report.

A number of other individuals have assisted in the Libby dam study. Engineers Clement W. West and Hollis G. Stritch were employed 3 weeks making reconnaissance and cost estimates of road construction. Engineer Kenneth B. Yeager was employed 2½ months on the reconnaissance of road routes and cost estimates thereof. Members of the regional forester's staff (Victor T. Linthacum, Fred W. Johnson, and William B. Apgar) each assisted a few days without cost to the project in studies of recreation, wildlife, and communication plans. The Northern Rocky Mountain Forest and Range Experiment Station assigned men to establish timber growth and volume study plots. Paul D. Kemp was assigned by the Station, without cost to the project, to prepare the "allowable annual cut" figures for the Libby and Troy Working Circles and the Zone of Influence. John Emerson of the Bitterroot National Forest served 2 weeks on the project, preparing a type map of the Zone of Influence and determining the "allowable annual cut" from the areas previously designated as winter logging chances.

The J. Neils Lumber Company of Libby has supplied a great deal of information on logging costs and costs of truck and rail transportation. The following concerns were consulted with regard to problems, equipment, and costs of using the reservoir for log transportation:

- Berger Engineering Company, Seattle, Washington
- Columbia Lumber Company, Roosevelt Lake, Washington
- Crown-Zellerback Corporation, Portland, Oregon
- Harbor Plywood Company, Chelatchie Prairie, Washington
- Lafferty Transportation Company, Coeur d'Alene Lake, Idaho, and Roosevelt Lake, Washington
- Lincoln Lumber Company, Roosevelt Lake, Washington
- Pointer-Willamette Company, Seattle, Washington
- Polson Lumber Company, Polson, Montana
- W. H. Rambo Engineering Company, Portland, Oregon
- Rayonier, Inc., Hoquiam, Washington
- Valsetz Lumber Company, Valsetz, Oregon
- Wyssen Skyline Crane Company, Switzerland

Russell Stevenson of the Bureau of Public Roads assisted in determining the type of bridge which would be required across the reservoir and estimating the cost of constructing it.

Areas within flowage of Dam Site 204.9[9/]

Tables 28 to 30[10/], inclusive, and figure 20 are based on the following assumptions: dam location, River Mile 204.9; maximum elevation of reservoir, 2459 feet. The map in figure 20 shows the location of the flowage.

Table 28. Area within flowage by class of land and ownership, Dam Site 204.9

	Public	Private	Total
	- - - - - Acres - - - - -		
Water and river channel	4,252	-	4,252
Tillable land	-	2,053	2,053
Grazing and wasteland	284	15,617	15,901
Timberland	8,549	6,927	15,476
Townsites	-	220	220
Total	13,085	24,817	37,902

Table 29. Ownership of private timberland, grazing, and wasteland in flowage, Dam Site 204.9

	Grazing and wasteland	Timber-land
	- - - Acres - - -	
J. Neils Lumber Company	223	3,900
Northern Pacific Railway	98	526
Other	15,296	2,501
Total	15,617	6,927

Table 30. Ownership of timber in flowage, Dam Site 204.9

	Thousand bd.ft.
J. Neils Lumber Company	19,500
Northern Pacific Railway	1,578
Other private	5,002
State	2,547
Federal	46,200
Total	74,827

9/Determined by planimetering Army topographic maps.

10/The terms "grazing and wasteland" and "timberland" as used in tables 28, 29, 31, and 32 are based on the county assessor's classifications. As other tables indicate, the majority of this area is "forest" by Forest Survey definition.

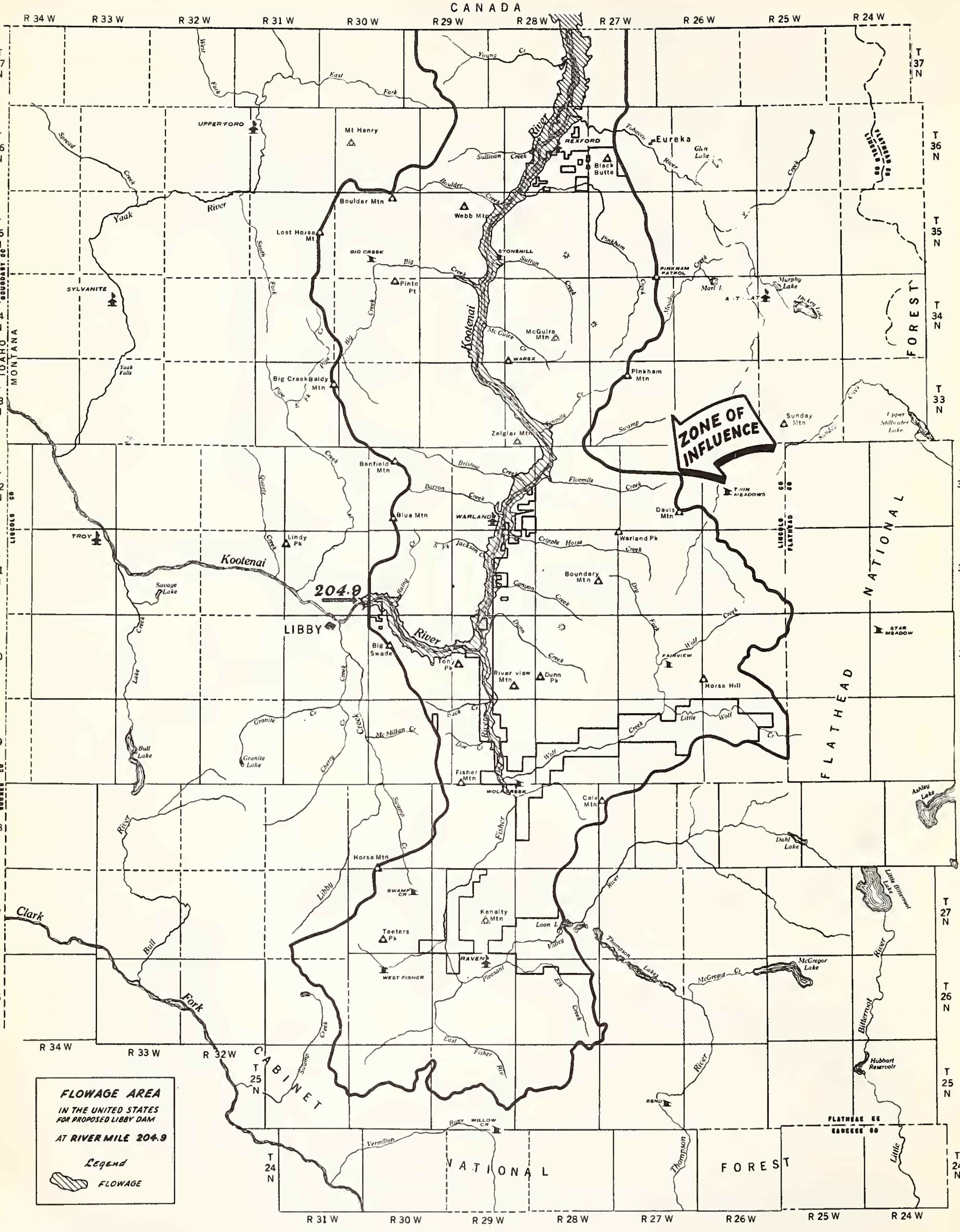

CANADA
ZONE OF INFLUENCE
204.9
LIBBY
Kootenai
River
FLOWAGE AREA
IN THE UNITED STATES FOR PROPOSED LIBBY DAM
AT RIVER MILE 204.9
Legend
FLOWAGE
CABINET
NATIONAL
FOREST
FLATHEAD
NATIONAL
FOREST

Figure 20

Areas within flowage of Dam Site 217.0

Tables 31 to 33[11], inclusive, and figure 21 are based on the following assumptions: dam location, River Mile 217.0; maximum elevation of reservoir, 2459 feet. The map in figure 21 shows the location of the flowage.

Table 31. Area within flowage by class of land and ownership, Dam Site 217.0

	Public	Private	Total
		Acres	
Water and river channel	3,427	-	3,427
Tillable land	-	1,753	1,753
Grazing and wasteland	183	14,518	14,701
Timberland	7,495	2,642	10,137
Townsites	-	220	220
Total	11,105	19,133	30,238

Table 32. Ownership of private timberland, grazing, and wasteland in proposed flowage, Dam Site 217.0

	Grazing and wasteland	Timberland
	Acres	
J. Neils Lumber Company	223	1,380
Other	14,295	1,262
Total	14,518	2,642

Table 33. Ownership of timber in flowage, Dam Site 217.0

	Thousand bd.ft.
J. Neils Lumber Company	6,900
Northern Pacific Railway	1,578
Other private	4,214
State	2,200
Federal	40,554
Total	55,446

11/The terms "grazing and wasteland" and "timberland" as used in tables 28, 29, 31, and 32 are based on the county assessor's classifications. As other tables indicate, the majority of this area is "forest" by Forest Survey definition.

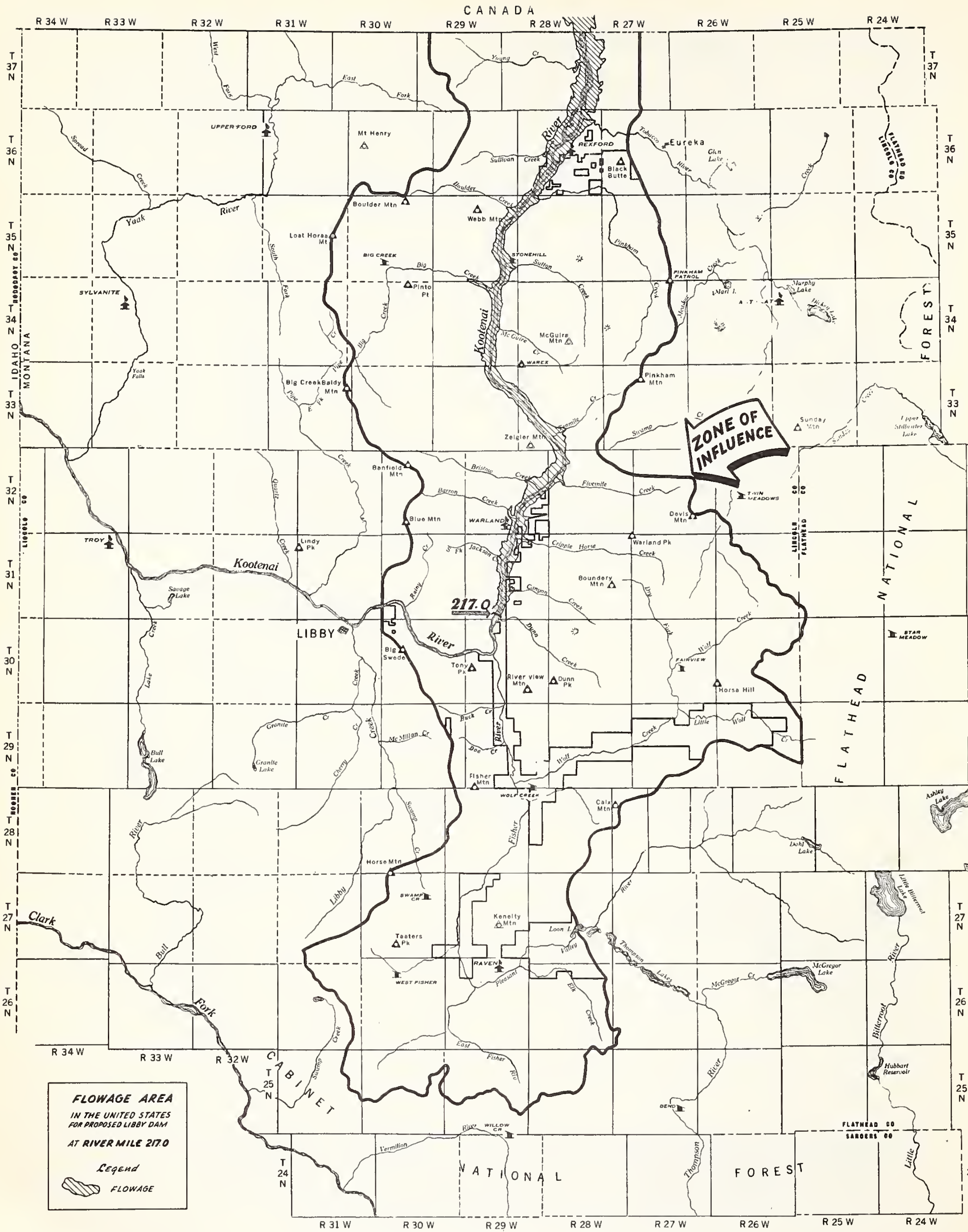

CANADA
ZONE OF INFLUENCE
FLOWAGE AREA
IN THE UNITED STATES FOR PROPOSED LIBBY DAM
AT RIVER MILE 217.0
Legend
FLOWAGE
217.0
LIBBY
Kootenai
River
Eureka
REXFORD
TROY
CABINET
NATIONAL
FOREST
FLATHEAD
IDAHO
MONTANA
R 34 W
R 33 W
R 32 W
R 31 W
R 30 W
R 29 W
R 28 W
R 27 W
R 26 W
R 25 W
R 24 W

Figure 21

Detailed timber resource statistics, Zone of Influence and Libby-Troy Working Circle

The timber resource data in this report came from two sources: J. Neils Lumber Company and Forest Survey statistics. Paul D. Kemp of the Forest Survey staff at the Northern Rocky Mountain Forest and Range Experiment Station made the calculations of allowable annual cut. Current estimates of both timber volume and allowable cut are considerably higher than those used in local timber management plans in years past. This is partly due to the fact that the present inventory of the timber resource is more complete and partly because improved economic conditions and improved equipment of recent years have made timber loggable which was formerly considered inaccessible or of too low quality to be merchantable.

The Zone of Influence includes a total of 808,139 acres of land area (before deduction for flowage), of which 99 percent, or 797,009 acres, is forest land. Figures 22 to 27, inclusive, and tables 34 to 37, inclusive, show the general character of the forest and classify the area and volume by ownership, species, stand-size class, and type of use. Tables 38 and 39 present the allowable cut estimates.

Winter logging areas

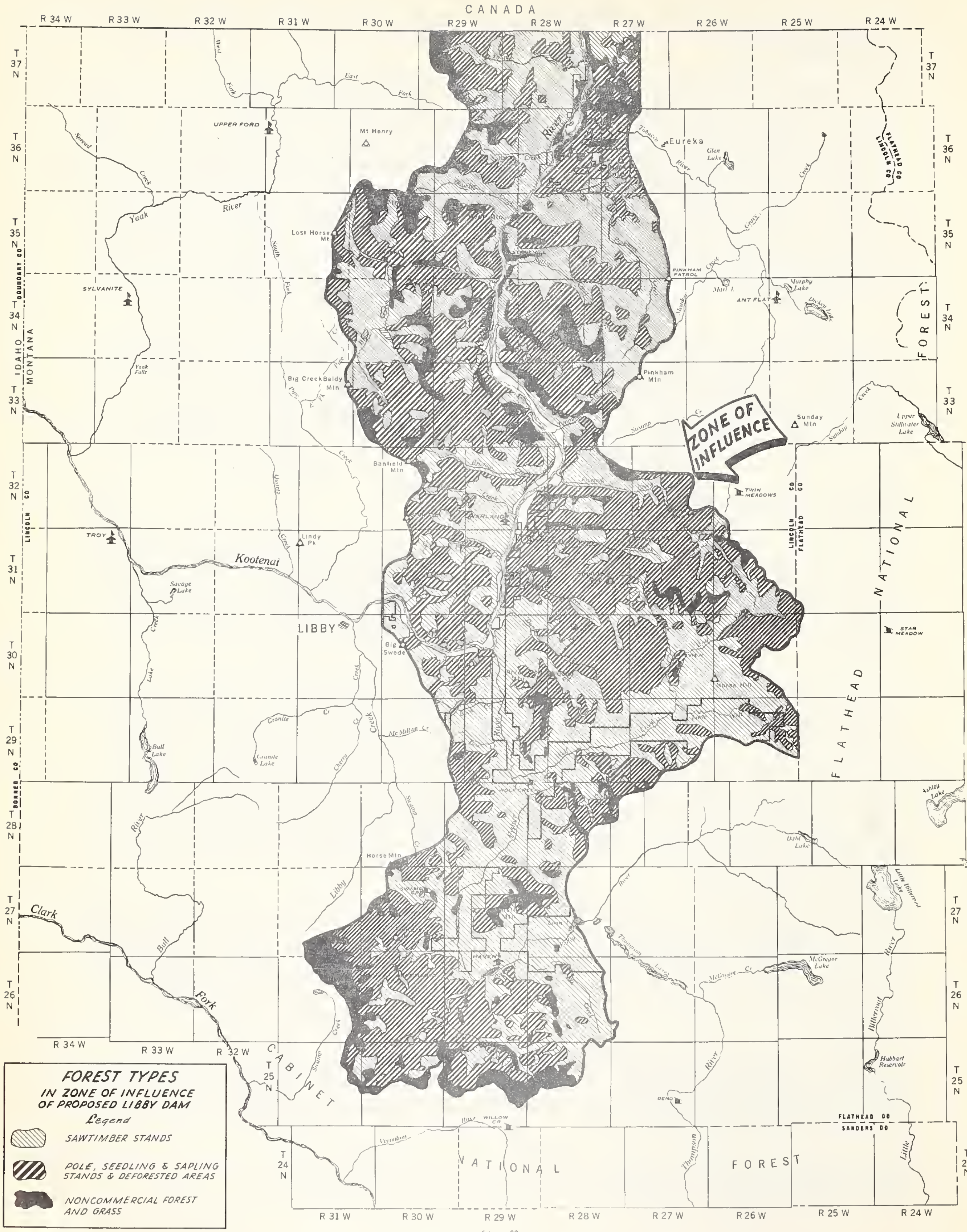
The areas suitable for logging in the winter in the Libby-Troy Working Circle were determined by C. S. Webb, project leader for the Libby dam study and Ernest Grambo, staff officer in charge of timber management and sales on the Kootenai National Forest. Both men are intimately familiar with the working circle and its logging problems.

In selecting these areas and outlining them on a map, two factors were taken into account: depth of snow and topography. More snow can be tolerated on level ground than on steeper and rougher areas. Figure 28 shows the location of winter logging areas in the Libby-Troy Working Circle. Figure 29 shows how much of the present sawtimber volume in each logging unit in the Zone of Influence is winter and summer logging. Table 40 shows the present sawtimber volume on winter logging areas and summer logging areas in the Zone of Influence and the entire Libby-Troy Working Circle.

Table 41 presents estimates of the annual allowable winter cut of sawtimber and cordwood for each logging unit group, the Zone of Influence, and the entire Libby-Troy Working Circle. Separate figures are presented for the upper and lower dam sites because of the different flowage deductions.

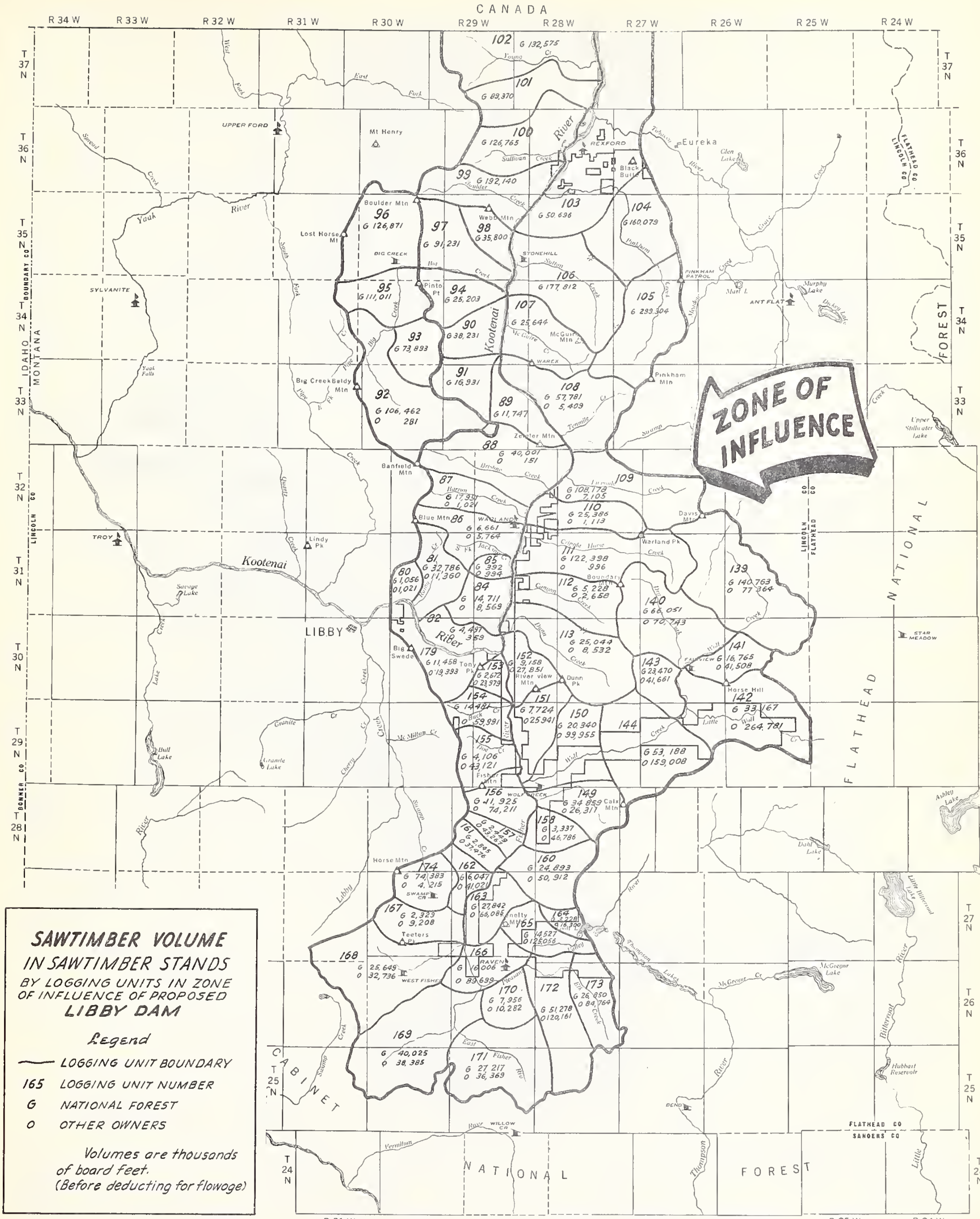
Table 42 compares the maximum available winter logging allowable cut with the winter allowable cut which would actually be recovered during the winter months in Study 1. The full amounts would be recovered in Studies 2, 3, 4, and 5.

Table 43 presents the summer, winter, and total allowable cut by individual logging units.



CANADA
ZONE OF INFLUENCE
FOREST TYPES
IN ZONE OF INFLUENCE
OF PROPOSED LIBBY DAM
Legend
SAWTIMBER STANDS
POLE, SEEDLING & SAPLING STANDS & DEFORESTED AREAS
NONCOMMERCIAL FOREST AND GRASS
Eureka
LIBBY
TROY
Kootenai
FLATHEAD NATIONAL FOREST
CABINET NATIONAL FOREST

Figure 22



CANADA
SAWTIMBER VOLUME
IN SAWTIMBER STANDS
BY LOGGING UNITS IN ZONE OF INFLUENCE OF PROPOSED
LIBBY DAM
Legend
LOGGING UNIT BOUNDARY
165 LOGGING UNIT NUMBER
G NATIONAL FOREST
O OTHER OWNERS
Volumes are thousands of board feet. (Before deducting for flowage)
ZONE OF INFLUENCE
CABINET NATIONAL FOREST
FLATHEAD NATIONAL FOREST
LIBBY
TROY
Eureka
REXFORD
Kootenai River
R 34 W
R 33 W
R 32 W
R 31 W
R 30 W
R 29 W
R 28 W
R 27 W
R 26 W
R 25 W
R 24 W
IDAHO
MONTANA
LINCOLN CO
FLATHEAD CO
SANDERS CO

Figure 23

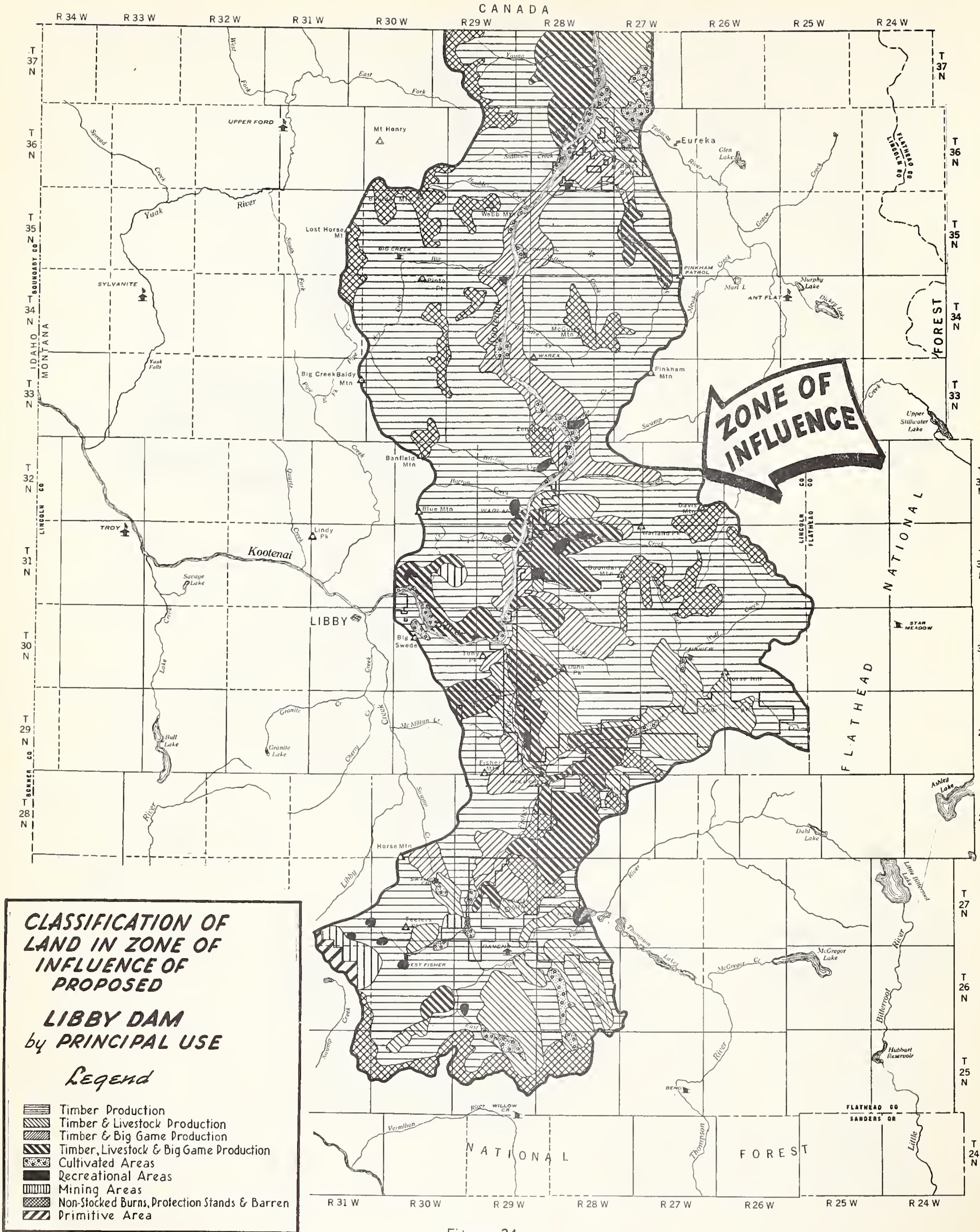

CLASSIFICATION OF LAND IN ZONE OF INFLUENCE OF PROPOSED
LIBBY DAM by PRINCIPAL USE
Legend
Timber Production
Timber & Livestock Production
Timber & Big Game Production
Timber, Livestock & Big Game Production
Cultivated Areas
Recreational Areas
Mining Areas
Non-Stocked Burns, Protection Stands & Barren
Primitive Area
ZONE OF INFLUENCE
CANADA
LIBBY
Eureka
Kootenai
FLATHEAD NATIONAL FOREST
NATIONAL FOREST

Figure 24

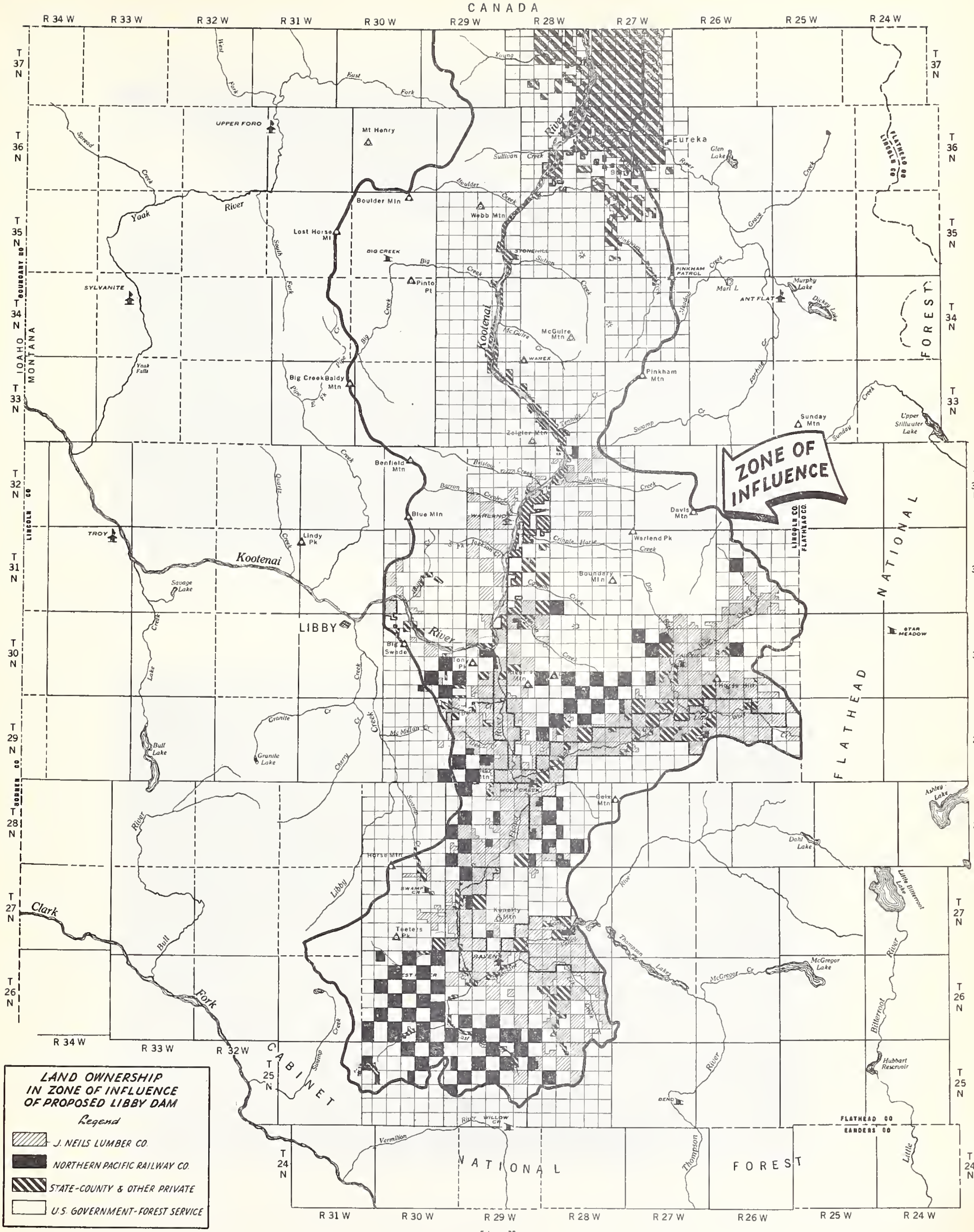

LAND OWNERSHIP
IN ZONE OF INFLUENCE
OF PROPOSED LIBBY DAM
Legend
J. NEILS LUMBER CO.
NORTHERN PACIFIC RAILWAY CO.
STATE-COUNTY & OTHER PRIVATE
U.S. GOVERNMENT-FOREST SERVICE
ZONE OF INFLUENCE
CANADA
R 34 W
R 33 W
R 32 W
R 31 W
R 30 W
R 29 W
R 28 W
R 27 W
R 26 W
R 25 W
R 24 W
T 37 N
T 36 N
T 35 N
T 34 N
T 33 N
T 32 N
T 31 N
T 30 N
T 29 N
T 28 N
T 27 N
T 26 N
T 25 N
T 24 N
IDAHO
MONTANA
BOUNDARY CO
LINCOLN CO
BONNER CO
LINCOLN CO.
FLATHEAD CO.
FLATHEAD CO
SANDERS CO
FLATHEAD NATIONAL FOREST
CABINET NATIONAL FOREST
LIBBY
Eureka
TROY
SYLVANITE
UPPER FORD
Kootenai
River
Yaak
Clark
Fork
Mt Henry
Boulder Mtn
Lost Horse Mt
Big Creek Baldy Mtn
Benfield Mtn
Blue Mtn
Lindy Pk
McGuire Mtn
Pinkham Mtn
Davis Mtn
Warland Pk
Boundary Mtn
Sunday Mtn
Zeigler Mtn
Webb Mtn
Horse Mtn
Teeters Pk
Kenelty Mtn
Geiger Mtn
Big Swede
Glen Lake
Murphy Lake
Dickey Lake
Upper Stillwater Lake
Ashley Lake
Dahl Lake
Little Bitterroot Lake
McGregor Lake
Hubbart Reservoir
Bull Lake
Granite Lake
Savage Lake
Thompson Lakes
Yaak Falls
PINKHAM PATROL
ANT FLAT
STAR MEADOW
BIG CREEK
WARLAND
WOLF CREEK
BEND

Figure 25

Sawlogs in deck and pond, Libby

Spruce logs from Big Creek

Figure 26

Figure 27. Timber stands, Rexford District

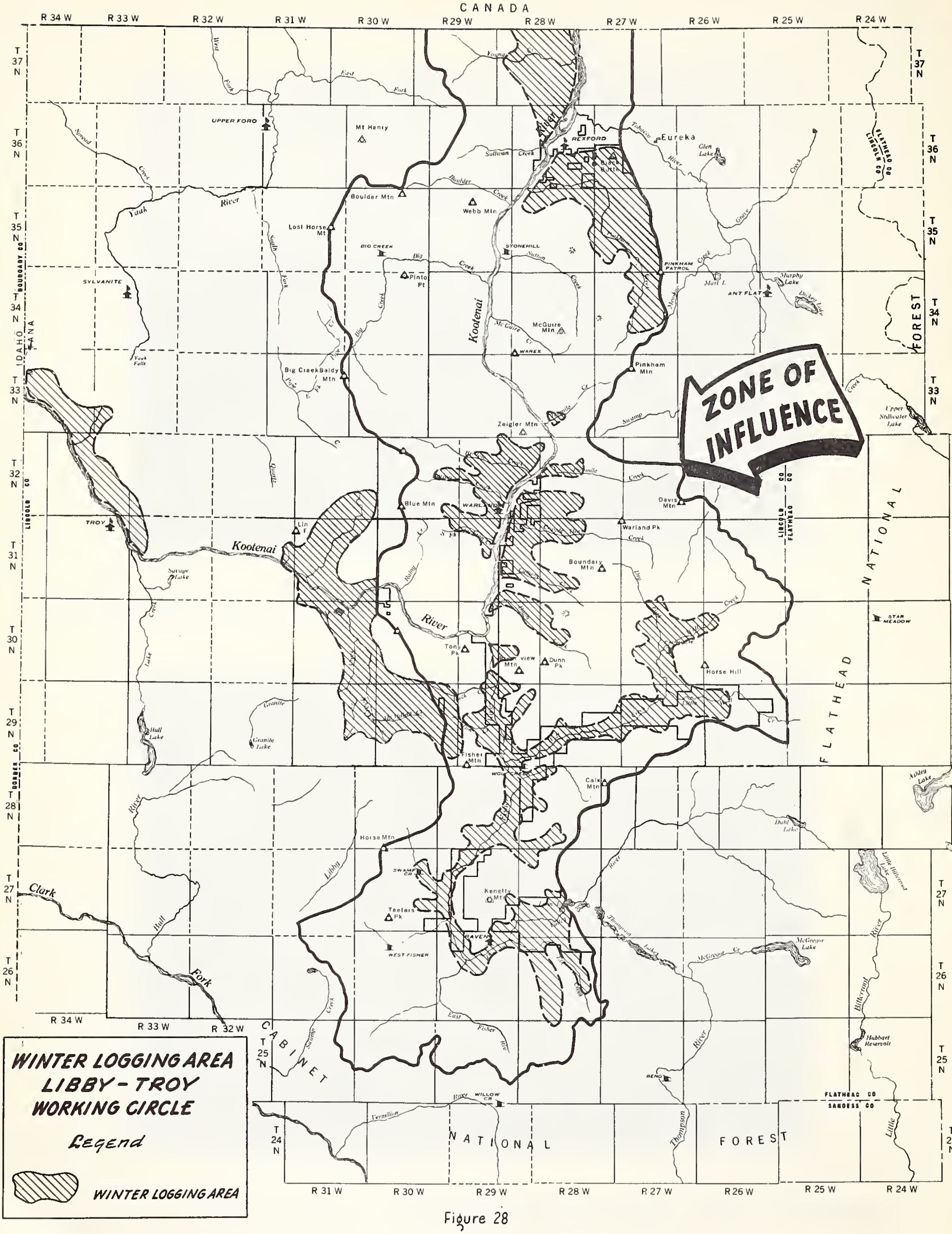

CANADA
ZONE OF INFLUENCE
WINTER LOGGING AREA
LIBBY - TROY
WORKING CIRCLE
Legend
WINTER LOGGING AREA
Kootenai
River
CABINET
NATIONAL
FOREST
FLATHEAD
NATIONAL
FOREST
REXFORD
Eureka
TROY
Mt Henry
Boulder Mtn
Webb Mtn
Lost Horse Mt
Pinto Pt
McGuire Mtn
Big Creek Baldy Mtn
Zeigler Mtn
Pinkham Mtn
Blue Mtn
Davis Mtn
Warland Pk
Boundary Mtn
Tony Pk
Dunn Pk
Horse Hill
Fisher Mtn
Calx Mtn
Horse Mtn
Kenelty Mt
Teeters Pk
UPPER FORD
SYLVANITE
BIG CREEK
STONEHILL
PINKHAM PATROL
ANT FLAT
STAR MEADOW
WEST FISHER
BEND
WILLOW CR
Murphy Lake
Dickey Lake
Glen Lake
Savage Lake
Hall Lake
Granite Lake
Ashley Lake
Dahl Lake
McGregor Lake
Hubbart Reservoir
Upper Stillwater Lake
Little Bitterroot Lake
Clark
Fork
Thompson
Vermillion
Yaak
Tobacco
Sullivan Creek
LINCOLN CO
FLATHEAD CO
SANDERS CO
BOUNDARY CO
IDAHO
MONTANA
R 34 W
R 33 W
R 32 W
R 31 W
R 30 W
R 29 W
R 28 W
R 27 W
R 26 W
R 25 W
R 24 W
T 37 N
T 36 N
T 35 N
T 34 N
T 33 N
T 32 N
T 31 N
T 30 N
T 29 N
T 28 N
T 27 N
T 26 N
T 25 N
T 24 N

Figure 28

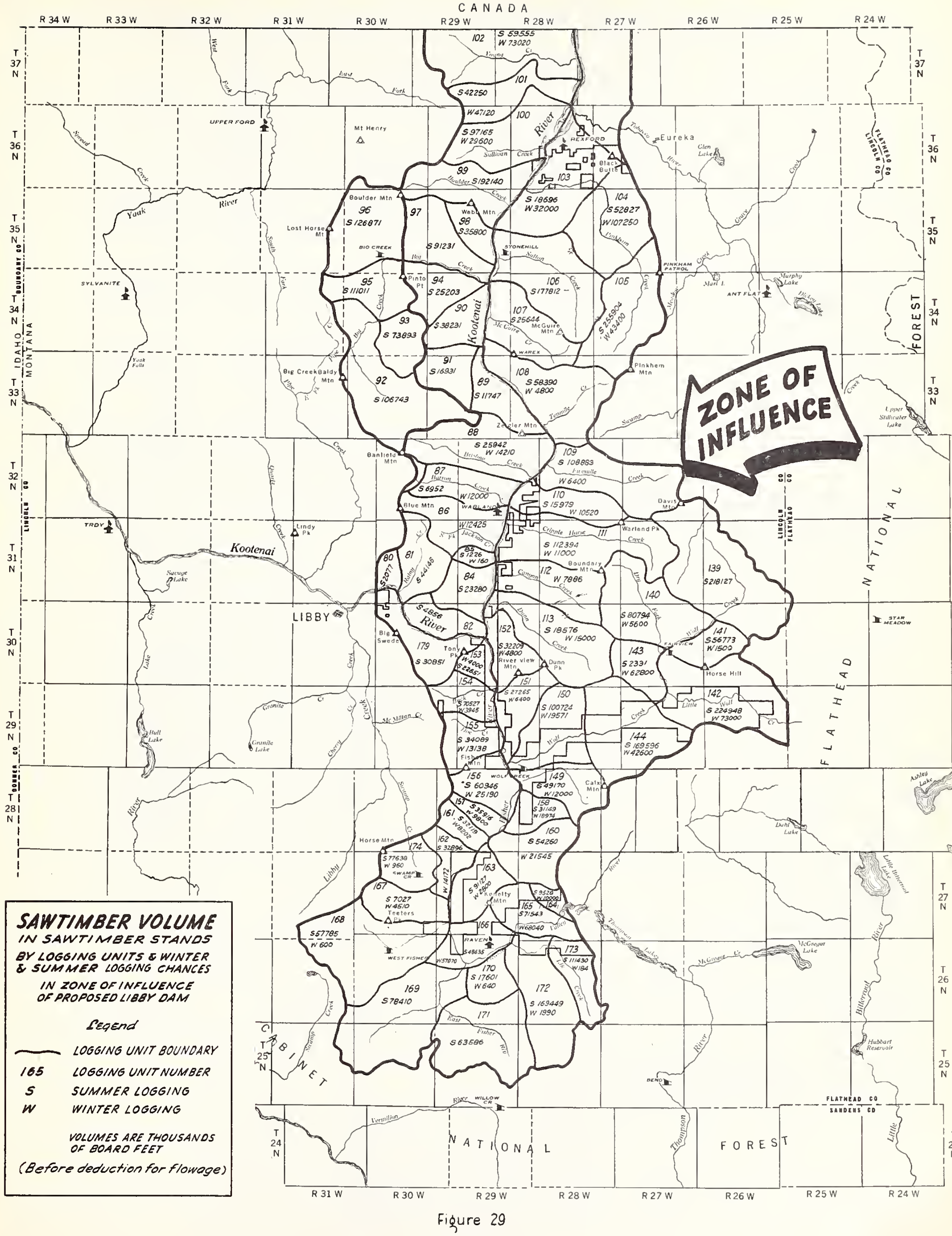

CANADA
ZONE OF INFLUENCE
SAWTIMBER VOLUME
IN SAWTIMBER STANDS
BY LOGGING UNITS & WINTER & SUMMER LOGGING CHANCES
IN ZONE OF INFLUENCE OF PROPOSED LIBBY DAM
Legend
LOGGING UNIT BOUNDARY
165 LOGGING UNIT NUMBER
S SUMMER LOGGING
W WINTER LOGGING
VOLUMES ARE THOUSANDS OF BOARD FEET
(Before deduction for flowage)
Kootenai River
LIBBY
Eureka
REXFORD
TROY
CABINET NATIONAL FOREST
FLATHEAD NATIONAL FOREST
IDAHO
MONTANA

Figure 29

Table 34. Forest area within Zone of Influence by stand-size class

Subzone	Commercial forest: Saw-timber	Commercial forest: Pole and: seedling: sapling	Commercial forest: Defor-ested	Commercial forest: Total	Non-commer-cial forest	Total forest
	- - - - - - - - - - - Acres - - - - - - - - - - -					
Kootenai River[1]	138,699	293,253	1,196	433,148	7,094	440,242
Fisher River[2]	193,818	164,155	5,888	363,861	4,036	367,897
Total before deduction	332,517	457,408	7,084	797,009	11,130	808,139
Dam Site 204.9						
Flowage deduction	15,476	15,200	701	31,377	-	31,377
Net area	317,041	442,208	6,383	765,632	11,130	776,762
Dam Site 217.0						
Flowage deduction	10,137	14,000	701	24,838	-	24,838
Net area	322,380	443,408	6,383	772,171	11,130	783,301

1/Logging units 80-82, 84-113, 179.
2/Logging units 139-144, 149-158, 160-174.

Table 35. Forest area within Zone of Influence by ownership

Subzone	National forest	State and private	Total
	- - - - - - - - - - Acres - - - - - - - - - -		
Kootenai River[1]	392,892	47,350	440,242
Fisher River[2]	176,301	191,596	367,897
Total before deduction	569,193	238,946	808,139
Dam Site 204.9			
Flowage deduction	7,871	23,506	31,377
Net area	561,322	215,440	776,762
Dam Site 217.0			
Flowage deduction	6,829	18,009	24,838
Net area	562,364	220,937	783,301

1/Logging units 80-82, 84-113, 179.
2/Logging units 139-144, 149-158, 160-174.

Table 36. Commercial forest area within Zone of Influence by types (before deduction for flowage)

Location	Status	White pine	Ponderosa pine	Larch-Douglas-fir	Douglas-fir	Engelmann spruce	Lodgepole pine	Cedar	Cedar white fir	Cottonwood	Total
		------	------	------	------	--Acres--	------	------	------	------	------
Kootenai River logging units 80-82 inc., 84-113 inc., and 179	Forest Service	7,033	50,944	149,515	4,090	27,835	144,076	11	180	211	383,895
	J.Neils Lbr.Co.	803	8,288	3,778	26	-	201	-	118	-	13,214
	Other	-	14,202	18,727	1,172	74	1,285	-	-	579	36,039
	Subtotal	7,836	73,434	172,020	5,288	27,909	145,562	11	298	790	433,148
Fisher River-Wolf Creek logging units 139-144 inc., 149-158 inc., 160-174 inc.	Forest Service	13,441	32,148	98,465	2,284	1,310	26,818	-	-	-	174,466
	J.Neils Lbr. Co.	172	75,187	43,577	551	307	2,524	-	-	-	122,318
	Other	6,292	22,773	32,949	959	149	3,955	-	-	-	67,077
	Subtotal	19,905	130,108	174,991	3,794	1,766	33,297	-	-	-	363,861
	Total	27,741	203,542	347,011	9,082	29,675	178,859	11	298	790	797,009

Table 37. Volume of sawtimber in Zone of Influence (before deduction for flowage)

Subzone	National forest	Other owners	Total
	- - - - Thousand board feet - - - - -		
Kootenai River	2,365,271	74,726	2,439,997
Fisher River	795,533	1,889,146	2,684,679
Total	3,160,804	1,963,872	5,124,676

Table 38. Allowable annual cut of sawtimber in Zone of Influence and Libby-Troy Working Circle (after deduction for flowage)

Logging unit group	Dam Site 204.9	Dam Site 217.0
	- - - - Thousand board feet - - - - -	
Kootenai River		
Libby	4,298	4,498
Warland	9,941	9,941
Stonehill	5,602	5,602
Rexford	8,898	8,898
Libby-Big Creek	4,205	4,205
Total	32,944	33,144
Fisher River		
Lower Fisher River	2,640	2,913
Mid-Fisher River	4,243	4,243
Wolf Creek	9,869	9,869
Upper Fisher River	10,778	10,778
Total	27,530	27,803
Total Zone of Influence	60,474	60,947
Balance Libby Working Circle	20,884	20,884
Total Libby Working Circle	81,358	81,831
Total Troy Working Circle	52,650	52,650
Total Libby-Troy Working Circle	134,008	134,481

Table 39. Allowable cut of cordwood material in Zone of Influence and Libby-Troy Working Circle (after deduction for flowage)

Logging unit group	Dam Site 204.9			Dam Site 217.0		
	Thinnings 1/	Tops, cull, understory 2/	Total	Thinnings 1/	Tops, cull, understory 2/	Total
	Cords					
Kootenai River						
Libby	3,984	2,765	6,749	4,584	3,065	7,649
Warland	10,160	6,394	16,554	10,160	6,394	16,554
Stonehill	5,360	3,604	8,964	5,360	3,604	8,964
Rexford	5,356	5,724	11,080	5,356	5,724	11,080
Libby-Big Creek	3,655	2,709	6,364	3,655	2,709	6,364
Total	28,515	21,196	49,711	29,115	21,496	50,611
Fisher River						
Lower Fisher	1,340	1,700	3,040	1,840	2,255	4,095
Mid-Fisher	1,820	2,733	4,553	1,820	2,733	4,553
Wolf Creek	5,987	6,360	12,347	5,987	6,360	12,347
Upper Fisher	7,739	6,943	14,682	7,739	6,943	14,682
Total	16,886	17,736	34,622	17,386	18,291	35,677
Total Zone of Influence	45,401	38,932	84,333	46,501	39,787	86,288
Balance Libby Working Circle	10,800	11,587	22,387	10,800	11,587	22,387
Total Libby Working Circle	56,201	50,519	106,720	57,301	51,374	108,675
Total Troy Working Circle	36,760	32,557	69,317	36,760	32,557	69,317
Total Libby-Troy Working Circle	92,961	83,076	176,037	94,061	83,931	177,992

1/ To be cut from young stands. 2/ To be cut from mature stands, in conjunction with sawtimber removal.

Table 40. Volume of sawtimber on winter and summer logging areas, Libby-Troy Working Circle (before deduction for flowage)

	Logging areas		
	Winter	Summer	Total
	- - - - Thousand board feet - - - -		
Kootenai River subzone	455,628	1,984,369	2,439,997
Fisher River subzone	670,843	2,013,836	2,684,679
Total Zone of Influence	1,126,471	3,998,205	5,124,676
Outside Zone of Influence			
Libby Working Circle	182,982	531,249	714,231
Troy Working Circle	52,368	1,646,551	1,698,919
Total Libby-Troy Working Circle	1,361,821	6,176,005	7,537,826

Table 41. Annual winter allowable cut (after deduction for flowage)

Logging unit group	Dam Sites 204.9 and 217.0	
	Sawtimber	Thinnings, tops, cull, and understory
	Thousand bd.ft.	Cords
Kootenai River		
Libby	511	712
Warland	3,510	5,311
Stonehill	-	-
Rexford	4,309	5,600
Libby-Big Creek	-	-
Total	8,330	11,623
Fisher River		
Lower Fisher	959	1,086
Mid-Fisher	1,115	1,201
Wolf Creek	2,032	2,472
Upper Fisher	1,794	1,742
Total	5,900	6,501
Total Zone of Influence	14,230	18,124
Balance Libby Working Circle	5,201	3,430
Total Libby Working Circle	19,431	21,554
Total Troy Working Circle	1,909	5,055
Total Libby-Troy Working Circle	21,340	26,609

Table 42. Annual winter allowable cut recovered in Study 1 compared with maximum available (after deduction for flowage)

Logging unit group	Sawtimber: Maximum available	Sawtimber: Recovered in Study 1	Other timber: Maximum available	Other timber: Recovered in Study 1
	Thousand board feet		Cords	
Kootenai River				
Libby	511	-	712	-
Warland	3,510	-	5,311	-
Stonehill	-	-	-	-
Rexford	4,309	-	5,600	-
Libby-Big Creek	-	-	-	-
Total	8,330	-	11,623	-
Fisher River				
Lower Fisher	959	-	1,086	-
Mid-Fisher	1,115	1,115	1,201	1,201
Wolf Creek	2,032	2,032	2,472	2,472
Upper Fisher	1,794	1,794	1,742	1,742
Total	5,900	4,941	6,501	5,415
Total Zone of Influence	14,230	4,941	18,124	5,415

Table 43. Allowable annual cut within Zone of Influence by logging units and summer and winter logging (flowage deducted)[1/]

Logging unit	Total summer and winter cutting: Sawlogs	Total summer and winter cutting: Cordwood: Thinnings	Total summer and winter cutting: Cordwood: Tops, cull, and understory trees	Total summer and winter cutting: Cordwood: Total	Summer cutting: Sawlogs	Summer cutting: Cordwood: Thinnings	Summer cutting: Cordwood: Tops, cull, and understory trees	Summer cutting: Cordwood: Total	Winter cutting: Sawlogs	Winter cutting: Cordwood: Thinnings	Winter cutting: Cordwood: Tops, cull, and understory trees	Winter cutting: Cordwood: Total
	Thousand bd.ft.	Cords	Cords	Cords	Thousand bd.ft.	Cords	Cords	Cords	Thousand bd.ft.	Cords	Cords	Cords
Libby group												
80	212	228	140	368	212	228	140	368	-	-	-	-
81	676	612	447	1,059	676	612	447	1,059	-	-	-	-
82	353	301	233	534	353	301	233	534	-	-	-	-
84	561	547	370	917	561	547	370	917	-	-	-	-
113	1,735	1,662	1,073	2,735	1,224	1,222	801	2,023	511	440	272	712
179	761	634	502	1,136	761	634	502	1,136	-	-	-	-
Total	4,298	3,984	2,765	6,749	3,787	3,544	2,493	6,037	511	440	272	712
Warland group												
85	171	209	113	322	171	203	109	312	-	6	4	10
86	843	904	557	1,461	354	380	234	614	489	524	323	847
87	913	964	603	1,567	479	506	317	823	434	458	286	744
88	1,355	1,332	895	2,227	744	686	491	1,177	611	646	404	1,050
89	438	469	290	759	438	469	290	759	-	-	-	-
108	1,254	1,146	828	1,974	1,113	1,105	801	1,906	141	41	27	68
109	1,435	1,238	948	2,186	1,202	1,114	860	1,974	233	124	88	212
110	606	568	400	968	195	276	194	470	411	292	206	498
111	1,859	2,053	1,055	3,108	1,164	1,332	662	1,994	695	721	393	1,114
112	1,067	1,277	705	1,982	571	771	443	1,214	496	506	262	768
Total	9,941	10,160	6,394	16,554	6,431	6,842	4,401	11,243	3,510	3,318	1,193	5,311
Stonehill group												
90	566	515	374	889	566	515	374	889	-	-	-	-
91	621	723	410	1,133	621	723	410	1,133	-	-	-	-
94	700	787	463	1,250	700	787	463	1,250	-	-	-	-
97	716	534	473	1,007	716	534	473	1,007	-	-	-	-
98	453	606	202	808	453	606	202	808	-	-	-	-
106	1,641	1,076	1,084	2,160	1,641	1,076	1,084	2,160	-	-	-	-
107	905	1,119	598	1,717	905	1,119	598	1,717	-	-	-	-
Total	5,602	5,360	3,604	8,964	5,602	5,360	3,604	8,964	-	-	-	-
Rexford group												
99	973	252	643	895	973	252	643	895	-	-	-	-
100	1,143	792	755	1,547	669	477	455	932	474	315	300	615
101	719	556	475	1,031	387	299	256	555	332	257	219	476
102	1,523	1,334	1,006	2,340	769	608	511	1,119	754	726	495	1,221
103	1,599	1,307	902	2,209	659	456	435	891	940	851	467	1,318
104	1,346	727	889	1,616	207	112	137	249	1,139	615	752	1,367
105	1,595	388	1,054	1,442	925	228	611	839	670	160	443	603
Total	8,898	5,356	5,724	11,080	4,589	2,432	3,048	5,480	4,309	2,924	2,676	5,600
Libby-Big Creek group												
92	1,922	2,056	1,201	3,257	1,922	2,056	1,201	3,257	-	-	-	-
93	541	419	357	776	541	419	357	776	-	-	-	-
95	805	450	532	982	805	450	532	982	-	-	-	-
96	937	730	619	1,349	937	730	619	1,349	-	-	-	-
Total	4,205	3,655	2,709	6,364	4,205	3,655	2,709	6,364	-	-	-	-
Total Kootenai River group	32,944	28,515	21,196	49,711	24,614	21,833	16,255	38,088	8,330	6,682	4,941	11,623

Table 43. Allowable annual cut within Zone of Influence by logging units and summer and winter logging (Cont.) (flowage deducted)1/

Logging unit	Total summer and winter cutting: Sawlogs	Total summer and winter cutting: Cordwood: Thinnings	Total summer and winter cutting: Cordwood: Tops, cull, and understory trees	Total summer and winter cutting: Cordwood: Total	Summer cutting: Sawlogs	Summer cutting: Cordwood: Thinnings	Summer cutting: Cordwood: Tops, cull, and understory trees	Summer cutting: Cordwood: Total	Winter cutting: Sawlogs	Winter cutting: Cordwood: Thinnings	Winter cutting: Cordwood: Tops, cull, and understory trees	Winter cutting: Cordwood: Total
	Thousand bd.ft.	Cords	Cords	Cords	Thousand bd.ft.	Cords	Cords	Cords	Thousand bd.ft.	Cords	Cords	Cords
						Lower Fisher group						
151	519	341	301	642	385	246	213	459	134	95	88	183
152	519	247	341	588	429	199	281	480	90	48	60	108
153	345	209	227	436	283	167	186	353	62	42	41	83
154	625	100	413	513	390	52	256	308	235	48	157	205
155	632	443	418	861	194	174	180	354	438	269	238	507
Total	2,640	1,340	1,700	3,040	1,681	838	1,116	1,954	959	502	584	1,086
						Mid-Fisher group						
149	708	429	468	897	595	361	393	754	113	68	75	143
156	637	218	421	639	401	137	265	402	236	81	156	237
157	284	91	187	278	217	70	143	213	67	21	44	65
158	375	98	248	346	226	59	150	209	149	39	98	137
160	875	411	578	989	671	315	443	758	204	96	135	231
161	317	121	209	330	247	94	163	257	70	27	46	73
162	436	275	218	493	282	178	116	294	154	97	102	199
163	611	177	404	581	489	142	323	465	122	35	81	116
Total	4,243	1,820	2,733	4,553	3,128	1,356	1,996	3,352	1,115	464	737	1,201
						Upper Fisher group						
174	952	809	629	1,438	850	722	562	1,284	102	87	67	154
164	144	18	95	113	30	4	20	24	114	14	75	89
165	692	109	457	566	316	50	209	259	376	59	248	307
166	680	60	449	509	272	24	180	204	408	36	269	305
167	594	694	392	1,086	475	555	314	869	119	139	78	217
168	1,580	1,613	1,044	2,657	1,569	1,602	1,037	2,639	11	11	7	18
169	1,951	2,155	1,113	3,268	1,951	2,155	1,113	3,268	-	-	-	-
170	494	250	326	576	471	238	311	549	23	12	15	27
171	1,588	1,354	1,049	2,403	1,588	1,354	1,049	2,403	-	-	-	-
172	1,468	646	970	1,616	1,031	453	681	1,134	437	193	289	482
173	635	31	419	450	431	22	285	307	204	9	134	143
Total	10,778	7,739	6,943	14,682	8,984	7,179	5,761	12,940	1,794	560	1,182	1,742
						Wolf Creek group						
139	2,270	2,015	1,500	3,515	2,270	2,015	1,500	3,515	-	-	-	-
140	1,499	1,197	991	2,188	1,039	830	687	1,517	460	367	304	671
141	512	285	338	623	436	243	288	531	76	42	50	92
142	2,010	684	1,168	1,852	1,479	503	817	1,320	531	181	351	532
143	633	536	418	954	327	277	216	493	306	259	202	461
144	1,959	1,019	1,294	2,313	1,530	796	1,011	1,807	429	223	283	506
150	986	251	651	902	756	193	499	692	230	58	152	210
Total	9,869	5,987	6,360	12,347	7,837	4,857	5,018	9,875	2,032	1,130	1,342	2,472
Total Fisher River group	27,530	16,886	17,736	34,622	21,630	14,230	13,891	28,121	5,900	2,656	3,845	6,501
Total Zone of Influence	60,474	45,401	38,932	84,333	46,244	36,063	30,146	66,209	14,230	9,338	8,786	18,124

1/Flowage deduction based on Dam Site 204.9.

So far as the restoration of facilities is concerned, the transportation planning of this report is limited to the Zone of Influence. The overall objective has been to determine what needs to be done in the Zone in the way of replacing facilities inundated or invalidated by the dam at either location. An answer to that question requires first of all the determination of the services that would be rendered by all existing facilities. In the case of transportation, we also need to estimate the probable extensions of existing facilities which would occur in the absence of a dam and the services they would render. In any case, the situation in the absence of a dam is a basing point against which to make comparisons. The analysis of this basing point is called "Study 0."

Study 0 transportation system

Study 0, insofar as it relates to the transportation of things and people, is based on the present transportation system as it would ultimately be developed if no dam were built. This ultimate system has been projected in the all-purpose transportation plan for the Kootenai National Forest. The all-purpose national forest transportation plan, to quote the Forest Service manual, is "the product of a systematic study of transportation requirements and the determination of a system of forest roads, trails, and landing fields that will most economically serve all forest resources, satisfy protection and administration requirements, and at the same time fully serve public travel needs which are not met by other transportation facilities."

Few national forest areas in the United States are served as well by transportation facilities as the area in the Libby dam Zone of Influence. Examination of figure 30, map of the Study 0 transportation system, shows these principal facilities:

1. Serving the Kootenai River Valley

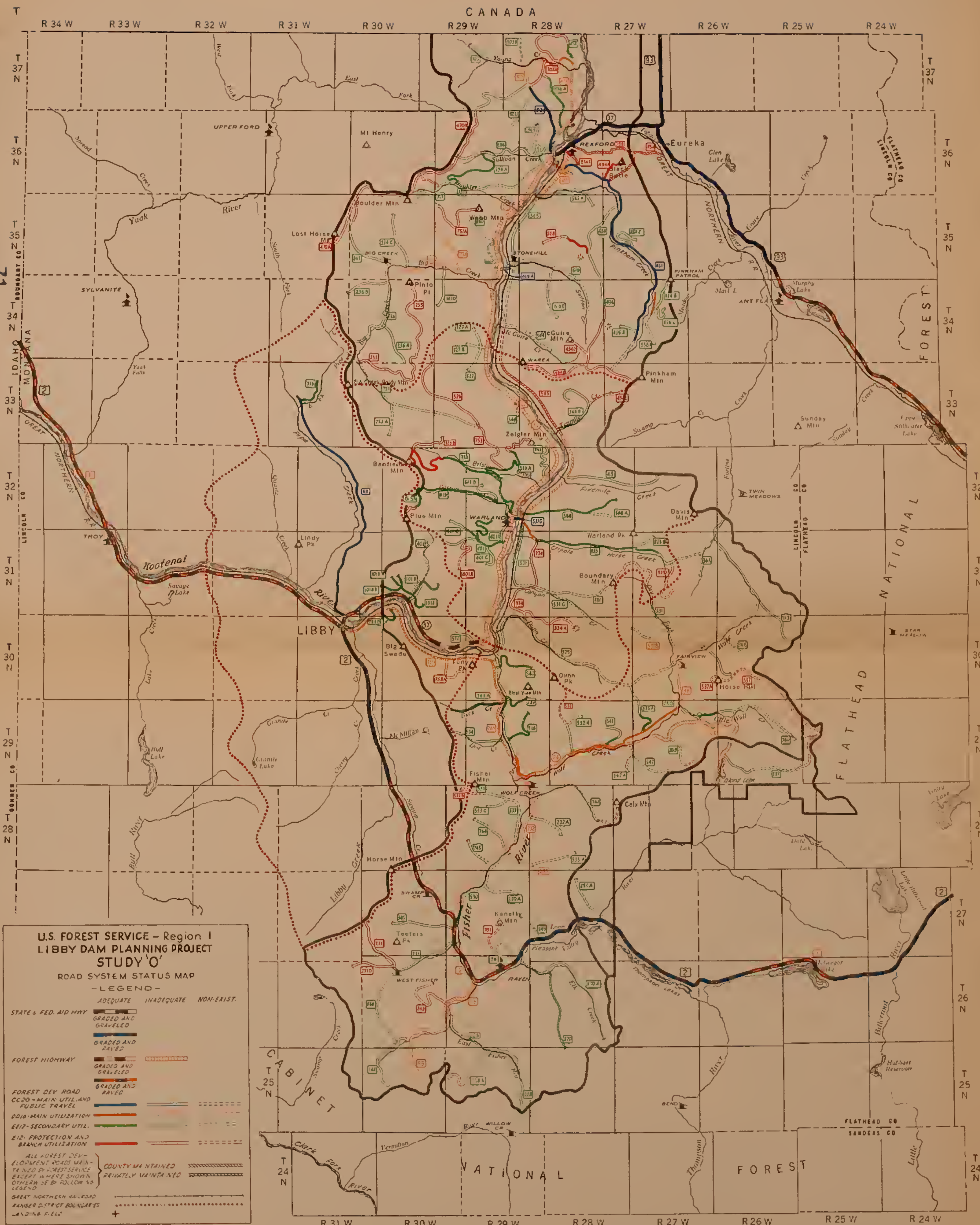
    a. The transcontinental Great Northern Railway on the east side of the river.

    b. State Highway 37 on the west side of the river, connecting U.S. Highways 2 and 93, and providing for public travel between Libby and Eureka.

    c. Permanent heavy-duty log haul bridges connecting Highway 37 and the railroad at Warland and Rexford, and a proposed additional bridge at Stonehill, serving logging sidings at those points.

    d. Forest development roads on the east side of the river connecting east-side timber areas with the railroad reload sidings.


CANADA
R 34 W
R 33 W


U.S. FOREST SERVICE – Region I
LIBBY DAM PLANNING PROJECT
STUDY 'O'
ROAD SYSTEM STATUS MAP
-LEGEND-
ADEQUATE
INADEQUATE
NON-EXIST.
STATE & FED. AID HWY
GRADED AND GRAVELED
GRADED AND PAVED
FOREST HIGHWAY
GRADED AND GRAVELED
GRADED AND PAVED
FOREST DEV. ROAD
CC20 - MAIN UTIL. AND PUBLIC TRAVEL
DD10 - MAIN UTILIZATION
EE12 - SECONDARY UTIL.
E12 - PROTECTION AND BRANCH UTILIZATION
COUNTY MAINTAINED
PRIVATELY MAINTAINED
GREAT NORTHERN RAILROAD
RANGER DISTRICT BOUNDARIES
LANDING FIELD
CANADA
R 34 W
R 33 W
R 32 W
R 31 W
R 30 W
R 29 W
R 28 W
R 27 W
R 26 W
R 25 W
R 24 W
T 37 N
T 36 N
T 35 N
T 34 N
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T 32 N
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T 30 N
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T 27 N
T 26 N
T 25 N
T 24 N
Eureka
REXFORD
LIBBY
TROY
WARLAND
STONEHILL
UPPER FORD
SYLVANITE
PINKHAM PATROL
WOLF CREEK
SWAMP CR.
WEST FISHER
RAVEN
FAIRVIEW
TWIN MEADOWS
ANT FLAT
BEND
WILLOW CR.
Kootenai River
Yaak River
Fisher River
Clark Fork River
Great Northern R.R.
IDAHO
MONTANA
BOUNDARY CO.
LINCOLN CO.
FLATHEAD CO.
SANDERS CO.
FLATHEAD NATIONAL FOREST
CABINET NATIONAL FOREST

Figure 30

2. Serving the Fisher River and Wolf Creek areas

   a. Privately owned and maintained heavy-duty log haul road on the forest development road system up the south side of the Kootenai River and the west side of Fisher River to Wolf Creek.

   b. Forest development road on the east side of Fisher River connected with the heavy-duty haul road on the west side of Fisher River by two existing and one proposed log haul bridges.

These facilities are the backbone of the Study O transportation system and provide access to all areas within the Zone of Influence through existing or proposed branch roads up side drainages. Moreover, they provide accessibility within time limits compatible with efficient fire control. The extensive road system shown in figure 30 has permitted widespread movement of manpower, supplies, and heavy fire fighting equipment with minimum restrictions and delays. The development of this road system had much to do with curtailing fire losses in the last quarter century from the high level of the period 1910-1925.

An examination of the Study O system shows it is ideal to the extent of providing a year-round means of log haul from all parts of the Zone of Influence to Libby--all downhill on a watergrade. This is an important consideration in trucking. Furthermore, the road system is such that "off-highway" log trucks can be used to good advantage without conflicting with legal load limits which are a necessary restriction on state highways and most county roads. Under present conditions, with heavy-duty bridges financed by the Forest Service or jointly by the Forest Service and Lincoln County at Warland and Rexford, "off-highway" trucks can be used to a considerable extent in hauling logs to the railroad reload sidings at these points without more than crossing State Highway 37. When the proposed bridge at Stonehill is constructed "off-highway" trucks will be usable in that area also (figures 31 and 32).

The J. Neils Lumber Company heavy-duty log haul road from Libby parallels the Great Northern railroad up the south side of the Kootenai River as far as the Fisher River, where it heads up the Fisher River and Wolf Creek drainages. It is now about 41 miles long. It is being extended up the Fisher River beyond Wolf Creek. The objective is to eventually connect with US Highway 2. Such an extension would allow economical truck haul of timber using "off-highway" equipment on downhill watergrade from all the Fisher River and Wolf Creek areas. At the present time, long distance log transportation from this latter area is handicapped by the necessary use of legal highway loads for the haul into Libby via US Highway 2.

Figure 31. Heavy-duty bridge across the Kootenai River at Warland.

Figure 32. Two bridges across the Kootenai River at Rexford. The nearer one is a heavy-duty bridge built for hauling logs. The one behind it is the highway bridge for regular traffic.

Figure 33 shows the steel girder and creosoted timber bridge crossing the Fisher River near the mouth of Wolf Creek on this company road. The bridge is typical of the type of the heavy-duty construction of the entire road which adequately carries log loads of 12,000 board feet, with gross weights of some 120,000 pounds, at speeds of 40 miles an hour. Incidentally, the deck of this bridge would be seven feet under water when the reservoir is filled.

As will be shown in later transportation cost comparisons, the Great Northern Railway provides the outlet for wood products from timber areas in the upper Kootenai River valley at costs and convenience that cannot be equalled by any other method of transportation. In the

Figure 33. Private logging bridge across the Fisher River.

past 10 years, about 30 million board feet or some 3300 cars of logs have been shipped annually to Libby from the Warland and Rexford sidings. Rail transportation permits all-weather operation, lower capital costs than an equivalent fleet of operator-owned trucks, economy, and dependability. These advantages are of particular importance to a lumbering operation which is handling a considerable portion of species with low-profit margins.

State Highway 37, in addition to being the most economical public travel route between Libby and Eureka, provides fast access for fire protection personnel from ranger stations at Libby, Warland, and Rexford. It also provides excellent access for the management of timber stands (cruising, marking, scaling, transportation of woods crews, equipment, etc.). Only short sections of the highway have so far been heavily used for hauling timber products. However, as cutting moves farther from Warland and Rexford, Highway 37 will become more and more important as a route from west-side areas to the Kootenai River bridges connecting with the railroad sidings. Traffic volumes on State Highway 37 for the period 1946-1951, as reported by the Montana District Office of the Bureau of Public Roads, are as follows:

Average daily (24-hour) traffic volume

Year	All cars and trucks	Commercial cars and trucks	Out-of-State passenger cars	Montana passenger cars
1946	75	29	6	40
1947	66	24	5	37
1948	81	36	6	39
1949	81	39	8	34
1950	91	41	6	44
1951	103	41	11	51

Even if there were no further industrial expansion at Libby and Eureka nor improvement in the Canadian highway feeding into US Highway 93, it is safe to say that the traffic counts above will increase at least 50 percent in the next 20 years.

The Study O transportation system includes the privately maintained heavy-duty access road up Rainy Creek from Highway 37 to the Zonolite mine operations. Vermiculite ore is trucked down this road to storage bins at the mouth of Rainy Creek. From these bins the material is conveyed across the Kootenai River to a railroad siding and loaded into box cars. The Libby dam at River Mile 204.9 would inundate these storage and loading facilities. Their restoration is a separate problem not considered in this study.

The federally owned airplane landing field at Libby, operated and maintained by the Forest Service, is an important part of the Study O transportation system. There is no other private or commercial field in the area. It is the operating base for routine aerial patrol flying during fire season and, in the case of large fires, becomes the receiving and dispatching center for men, equipment, and supplies. Although located outside the reservoir area, this field would have to be replaced as its site probably would be the source of concrete aggregate for the dam. Furthermore, the dam itself would obstruct the normal flight approach to and from the field.

In anticipating the potential development of the area, it is essential to note that it has the following outside links:

1. The transcontinental Great Northern Railway.

2. US Highway 2, which affords direct connection to Spokane, Seattle, and the other major population areas on the west coast with Montana's Glacier National Park, and other points to the east.

3. US Highway 93, which connects Nevada and Idaho in the south with Calgary and the Banff National Park scenic and recreational areas in Canada.

Only part of the Study O system is now in existence. Furthermore, figure 30 shows that some of the road though in existence is of inadequate standard. Table 44 shows the mileage of the Study O system as well as replacement values, cost to construct or complete, and annual maintenance cost. These data are presented in greater detail in table 45.

The roads in table 44 are divided into two categories (1) mainline roads which would be inundated or affected and which would have to be replaced one way or another and (2) all other roads in the Zone of Influence. The 138.5 miles in category 1 of this table would be flooded and have to be replaced.[12] These roads have a 1951 replacement value of $3,598,000. They require an additional investment of $2,752,000 to bring certain sections up to a satisfactory standard and to construct others not yet built.

The reconstruction of State Highway 37 is the largest single item of cost in the completion of the Study O transportation system to a satisfactory standard. Figure 30 shows only two sections of this highway are presently up to standard. They are the 8.3-mile portion starting immediately north of Libby, constructed in 1950 with a 28-foot oil mat, and the 9.2-mile section from the Rexford Bridge to Eureka, constructed in 1944 with a 24-foot oil mat. The remaining 45.9 miles, for the most part, were built from 1922 to 1924 with a 16-foot surface, although widened subsequently through maintenance to various widths between 16 feet and 20 feet. This narrow portion and a number of short-radius blind curves make the existing highway inadequate for combined traffic. Accordingly, the expense of reconstructing the 45.9 miles to a 24-foot surfaced width, in addition to replacement of the substandard state

12/ Many roads would, of course, be flooded where they tie into the main highway. However, these sections would not need to be replaced.

Table 44. Roads on the Study O transportation system

	Miles				Estimated costs		
	Adequate	In-adequate	Non-existing	Total	Replacement value of existing mileage	Cost to complete	Annual cost to maintain
					- - - - - - - -Dollars- - - - - - - -		
Main line or valley bottom roads to be inundated or affected							
State Highway 37	17.5	45.9	-	63.4	2,544,000	2,175,000	46,740
Libby-Jennings 759	13.6	-	-	13.6	569,000	-	2,720
West side Fisher River 763	8.5	-	-	8.5	255,000	-	1,490
East side Fisher River (FH 4) (Mouth Fisher River to Wolf Creek)	2.0	6.0	2.5	10.5	74,500	62,700	1,030
Warland-Canyon Creek 531	-	7.0	-	7.0	24,500	31,500	875
Tweed-Rexford 565	3.0	24.6	7.9	35.5	130,900	483,300	4,635
Subtotal	44.6	83.5	10.4	138.5	3,597,900	2,752,500	57,490
All other forest development roads	174.8	308.6	437.8	921.2	3,655,290	8,650,510	103,120
Total	219.4	392.1	448.2	1059.7	7,253,190	11,403,010	160,610

Table 45. Status of principal existing and proposed roads within the Zone of Influence

Study O

Road number	Road name and termini of sections	Total length	Section length	Construction standard: Existing	Construction standard: Proposed	Status: Adequate	Status: Inadequate	Status: Non-existing	Replacement value (1951 index)	Cost to complete (1951 index)	Estimated annual maintenance cost of proposed standard
		- - Miles - -				- - - Miles - - -			- - - - - Dollars - - - - -		
State roads, Libby to Eureka[1]		63.4									
State High-	FHP 57C, FAP 118D (1)		8.3	AA-28	AA-28	8.3	-	-	539,000	-	5,810
way 37	FAP 118A and FAP 118C		3.9	AA-28	AA-28	-	3.9	-	195,000	58,500	2,730
(Forest	FAP 118A and FAP 145D		10.6	DD-18	AA-24	-	10.6	-	424,000	689,000	7,420
Highway	FHP 57B		10.4	DD-18	AA-24	-	10.4	-	208,000	395,000	7,280
57)	FHP 57A		10.3	DD-18	AA-24	-	10.3	-	258,000	391,500	7,210
	FAP 145A and FAP 137A		10.5	DD-18	AA-24	-	10.5	-	315,000	399,000	7,350
	Rexford bridge and approaches		0.2	H-10 18 feet	H-20 26 feet	-	0.2	-	145,000	242,000	2,500
	FAP 137B		9.2	B-24	B-24	9.2	-	-	460,000	-	6,440
	Total for State Highway 37	63.4				17.5	45.9		2,544,000	2,175,000	46,740
Forest development roads											
Forest Highway 4	Jennings - Marion (Class 3)	33.5									
	Jennings to road 763		9.5	F-10	EE-12	1.0	6.0	2.5	49,500	62,700	855
	Road 763 to Zone boundary		24.0	F-10	DD-16	6.0	18.0	-	266,000	520,000	4,200[2]
Forest Highway 58	Manicke - Trout Creek (Class 3)	13.0	13.0	F-10	DD-16	-	8.0	5.0	36,000	455,000	1,490 785[2]
36	Fortine Creek - Wolf Creek	25.5									
	Forest Highway 4 to road 113		17.0	F-10	DD-16	6.0	11.0	-	81,500	357,500	2,975
	Road 113 to road 36A		5.5	F-9	EE-12	-	5.5	-	10,000	72,600	500
	Road 36A to Summit		3.0	F-9	EE-12	-	3.0	-	9,000	52,000	270
36A	Weigel Creek spur	5.0	-	-	EE-12	-	-	5.0	-	37,500	350
36D[3]	Wolf Creek - Forest Highway 4 cutoff	3.0	-	F-10	EE-12	-	3.0	-	6,000	28,500	270
36E[3]	No Name Creek spur	2.0	-	-	EE-12	-	-	2.0	-	17,000	180
48	Five Mile Creek	8.9	-	E-12	EE-12	-	8.9	-	57,850	363,750	1,110
48B	South Fork	3.0	-	E-12	EE-12	-	-	3.0	-	19,500	210
92	Yaak Valley - West Side	12.8									
	Forest Highway 57 to road 92E		6.0	CC-20	CC-20	6.0	-	-	165,000	-	850 500[2]
	Road 92E to road 470		6.8	F-9	EE-12	-	6.8	-	20,400	78,200	850
92E	Young Creek connection	2.0	-	-	DD-16	-	-	2.0	-	29,000	350
92K[3]	Rexford bridge and approaches	1.1	-	DD-16	DD-16	1.1	-	-	120,000	-	1,500
92L[3]	South spur	3.5	-	-	EE-12	-	-	3.5	-	45,500	315
113	Tally Lake - Brush Creek	4.8	-	F-10	EE-12	-	4.8	-	14,400	64,800	430
148	Silver Butte Pass	6.5	-	F-10	EE-12	-	6.5	-	26,000	87,750	585
228	East Fisher	11.5	-	F-10	EE-12	-	11.5	-	51,750	156,500	1,440
228A	Allen Peak	9.0									
	Road 228 to head Himes Creek		4.0	-	EE-12	-	-	4.0	-	48,000	360
	Head Himes Creek to Allen Peak		5.0	-	E-12	-	-	5.0	-	32,500	350
231	Libby Creek - Fisher River	11.3									
	State Highway 2 to road 231D		5.3	F-12	EE-12	-	5.3	-	10,600	60,950	210 270[2]
	Road 231D to north district boundary		6.0	F-10	E-12	-	6.0	-	12,000	36,000	420
231D	Bramlet Creek	4.7	-	F-9	E-12	-	4.7	-	12,000	21,150	330
232	Fisher River	14.3	-	F-10	DD-16	-	14.3	-	40,000	393,250	2,505
232A[3]	Snell Creek	3.0	-	-	EE-12	-	-	3.0	-	34,500	210
255	Garden Ridge	20.0	-	F-9	E-12	-	9.1	10.9	23,000	126,000	1,400
257A	Wabuno Creek	4.0	-	-	EE-12	-	-	4.0	-	46,000	360
303	Ferry road	8.0									
	Road 474 to Section 18, T37N, R28W		4.5	DD-16	DD-16	3.0	0.5	1.0	52,500	26,250	790
	Section 18, T37N, R18W to head Young Creek		3.5	-	EE-12	-	-	3.5	-	40,250	315
303A	Dodge Creek connection	4.0	-	F-9	E-12	-	4.0	-	3,000	18,000	280
303B[3]	North spur	2.5	-	-	EE-12	-	-	2.5	-	28,750	225
333	Bristow Creek	12.9									
	Road 615 to head Bristow Creek		7.5	EE-12	EE-12	7.5	-	-	64,000	-	940
	Head Bristow Creek to Banfield Mtn.		5.4	E-12	E-12	5.4	-	-	29,700	-	380
333A	Ziegler Mountain	11.8									
	Road 333 to Section 3, T32N, R29W		6.8	EE-12	EE-12	6.8	-	-	64,600	-	610
	Section 3 to Ziegler Mountain		5.0	F-10	E-12	-	5.0	-	12,000	32,500	350
333B	Lost Souls road	4.7	-	F-10	E-12	-	4.7	-	11,750	16,500	330

Table 45. Status of principal existing and proposed roads within the Zone of Influence (Cont.)

Study O

Road number	Road name and termini of sections	Total length	Section length	Construction standard: Existing	Construction standard: Proposed	Status: Adequate	Status: Inadequate	Status: Non-existing	Replacement value (1951 index)	Cost to: complete (1951 index)	Estimated annual maintenance cost of proposed standard
		- - Miles - -				- - - Miles - - -			- - - - - Dollars - - - - -		
334	Upper Canyon Creek	14.5									
	Warland to road 835		5.0	DD-16	DD-16	5.0	-	-	75,000	-	615 260[2]
	Road 835 to road 525		9.5	F-10	E-12	-	9.5	-	24,000	42,750	665
334A[3]	Hornet Ridge	5.0	-	F-10	E-12	-	3.5	1.5	7,000	11,800	350
336	Big Creek - Pipe Creek	16.3									
	Forest Highway 57 to Copeland Creek		10.5	F-10	DD-16	-	10.5	-	32,500	472,500	1,840
	Copeland Creek to Summit		5.8	F-10	EE-12	-	5.8	-	15,000	133,400	725
336A	Lookout Creek	3.5	-	-	EE-12	-	-	3.5	-	38,500	315
336B	Copeland Creek	4.0	-	-	EE-12	-	-	4.0	-	44,000	360
336C	Good Creek	4.0	-	-	EE-12	-	-	4.0	-	30,000	360
336D	Steep Creek	4.5	-	-	EE-12	-	-	4.5	-	51,750	405
337	Boulder Creek	12.5									
	Road 596 to Section 31, T36N, R29W		10.0	-	EE-12	-	-	10.0	-	175,000	1,250
	Section 31 to road 470		2.5	-	E-12	-	-	2.5	-	19,000	175
385	Miller Creek	5.0	-	F-10	EE-12	-	5.0	-	6,500	36,500	350
401	Rainy - Jackson Creek	11.5									
	Forest Highway 57 to road 401B		3.0	EE-12	EE-12	3.0	-	-	21,000	-	375
	Road 401B to Zonolite road		8.5	E-12	EE-12	-	3.0	5.5	13,500	140,250	765
401A	Fleetwood Point	3.9	-	F-10	E-12	-	3.4	0.5	10,200	17,550	275
401B	North Fork	5.4	-	E-12	EE-12	3.2	2.2	-	26,900	11,000	485
401C	Little Jackson spur	2.0	-	F-12	EE-12	-	2.0	-	5,000	10,000	140
401D[3]	North Fork spur	2.5	-	EE-12	EE-12	2.5	-	-	16,500	-	175
470	Dodge Summit	27.4	-	F-10	E-12	-	10.4	17.0	68,000	151,000	1,920
470A	Lost Horse Mountain	1.0	-	-	E-12	-	-	1.0	-	6,500	70
470B	Red Mountain	0.4	-	F-12	E-12	-	0.4	-	3,000	3,000	35
474	Rexford - Gateway	7.5	-	DD-16	DD-16	7.5	-	-	135,000	-	1,315[2]
474A	Poverty Creek	4.8	-	EE-12	EE-12	4.0	0.8	-	56,800	11,200	600
494	Sutton Ridge - Swamp Creek	20.5									
	Road 856 to south line Section 12		11.0	F-12	EE-12	-	11.0	-	42,000	115,500	990
	South line Section 12 to Ten Mile Summit		9.5	F-12	E-12	-	9.5	-	36,000	55,100	855
494A	Black Butte lookout	3.0	-	E-12	E-12	3.0	-	-	18,000	-	210
494B	Warex	5.8	-	-	E-12	-	-	5.8	-	30,000	410
494D	McGuire Mountain	1.8	-	-	E-12	-	-	1.8	-	12,000	125
494E[3]	Ten Mile connection	3.5	-	-	E-12	-	-	3.5	-	20,000	245
525	Dunn Creek - Wolf Creek	20.9									
	Forest Highway 4 to north line Section 27		12.9	F-10	EE-12	-	8.4	4.5	50,500	118,950	1,615
	North line Section 27 to Fairview		8.0	-	EE-12	-	-	8.0	-	76,000	1,000
525A	South highway connection	5.0	-	EE-12	EE-12	2.5	-	2.5	20,000	25,000	450
525B[3]	Fisher River bridge and approaches	0.1	-	-	H-30 14 feet	-	-	0.1	-	50,000	550
526	Parsnip Mountain	9.4	-	-	E-12	-	-	9.4	-	52,000	660
527[3]	Parsnip Creek	2.5	-	-	EE-12	-	-	2.5	-	35,000	310
527A[3]	North Fork Parsnip Creek	1.5	-	-	EE-12	-	-	1.5	-	13,500	135
527B[3]	Middle Fork Parsnip Creek	1.0	-	-	EE-12	-	-	1.0	-	9,000	90
528	Beartrap Mountain	3.7	-	E-12	E-12	2.0	-	1.7	10,000	10,000	120
530	East side Fisher River	9.2	-	EE-12	EE-12	1.5	-	7.7	18,000	88,550	1,150
530A[3]	Smoke Creek	3.0	-	-	EE-12	-	-	3.0	-	34,500	210
531	Warland - Canyon Creek	27.5									
	Fairview to road 531B		1.0	-	DD-16	-	-	1.0	-	16,000	175
	Road 531B to north line Section 32		4.0	-	EE-12	-	-	4.0	-	34,000	360
	North line Section 32 to north line Section 27		8.0	-	E-12	-	-	8.0	-	43,000	560
	North line Section 27 to Warland		14.5	F-10	EE-12	-	7.0	7.5	24,500	88,500	1,440 375[2]
531B	West Dry Fork	4.0									
	Road 531 to Section 8, T30N, R27W		2.0	-	DD-16	-	-	2.0	-	29,000	350
	Section 8 to head West Dry Fork		2.0	-	EE-12	-	-	2.0	-	19,000	180
531C	Canyon Creek	4.0	-	-	EE-12	-	-	4.0	-	34,000	360
531D	Warland bridge and approaches	0.1	-	H-30 20 feet	H-30 20 feet	0.1	-	-	220,000	-	800

Table 45. Status of principal existing and proposed roads within the Zone of Influence (Cont.)

Study O

Road number	Road name and termini of sections	Total length	Section length	Construction standard: Existing	Construction standard: Proposed	Status: Adequate	Status: Inadequate	Status: Non-existing	Replacement value (1951 index)	Cost to complete (1951 index)	Estimated annual maintenance cost of proposed standard
		Miles	Miles			Miles	Miles	Miles	Dollars	Dollars	Dollars
532	Richards Mountain	8.5									
	Forest Highway 4 to Mt. Sterling		3.5	-	EE-12	-	-	3.5	-	31,500	315
	Mt. Sterling to Richards Mountain		5.0	-	E-12	-	-	5.0	-	40,000	350
532A[3]	East Fork Richards Creek	1.5	-	-	EE-12	-	-	1.5	-	13,500	135
533	Swede Creek - Brush Creek	7.0									
	Road 232 to Section 4, T28N, R29W		5.5	-	EE-12	-	-	5.5	-	45,000	685
	Section 4 to Summit		1.5	-	E-12	-	-	1.5	-	7,500	100
533B	Fisher Mountain	1.0	-	-	E-12	-	-	1.0	-	4,000	70
533C	Brush Creek	2.0	-	-	EE-12	-	-	2.0	-	18,000	180
534	McMillan - Doe Creek	5.0	-	E-12	EE-12	-	2.5	2.5	16,500	37,500	450
535	McKillop - Loon Lake	9.0	-	-	DD-16	-	-	9.0	-	157,500	1,575
535A	McKillop Creek	5.5	-	-	EE-12	-	-	5.5	-	48,000	495
537	Sanders Mountain Divide	26.0									
	Forest Highway 4 to south line Section 25		7.0	F-10	EE-12	-	3.0	4.0	7,500	50,000	875
	South line Section 25 to road 537A		15.5	-	E-12	-	-	15.5	-	95,000	1,395
	Road 537A to road 36		3.5	-	EE-12	-	-	3.5	-	31,500	435
537A[3]	Horse Hill lookout	1.5	-	-	E-12	-	-	1.5	-	9,000	100
538[3]	Cody Creek	3.5	-	EE-12	EE-12	3.5	-	-	28,000	-	315
539[3]	Alder Creek	2.5	-	EE-12	EE-12	2.5	-	-	20,000	-	225
540[3]	Butler Creek	4.5	-	EE-12	EE-12	4.5	-	-	42,000	-	405
541[3]	Backus Creek	3.0	-	EE-12	EE-12	1.0	-	2.0	9,000	18,000	270
542[3]	Tamarack Creek	6.5	-	-	EE-12	-	-	6.5	-	65,000	585
542A[3]	West Fork Tamarack Creek	1.5	-	-	EE-12	-	-	1.5	-	15,000	135
543[3]	Crystal Creek	3.0	-	-	EE-12	-	-	3.0	-	25,500	270
544[3]	Geibler Creek	3.0	-	-	EE-12	-	-	3.0	-	34,500	270
545[3]	Ural Creek	3.0	-	-	EE-12	-	-	3.0	-	34,500	270
564[3]	McGuire Creek	4.0	-	-	EE-12	-	-	4.0	-	88,000	500
565	Tweed - Rexford	35.5									
	Road 566 to road 565B		8.5	E-12	DD-16	-	8.5	-	51,000	140,250	1,485[2]
	Road 565B to Ural		3.0	E-12	E-12	3.0	-	-	22,000	-	270[2]
	Ural to road 564		8.8	F-10	E-12	-	5.9	2.9	27,500	75,650	270 520[2]
	Road 564 to road 565A		11.5	F-9	EE-12	-	6.5	5.0	18,200	175,400	1,440
	Road 565A to Rexford		3.7	F-10	DD-16	-	3.7	-	12,200	92,000	650[2]
565A	Pinkham Creek	4.8	-	F-10	EE-12	-	4.8	-	8,640	45,600	600
565B	Ten Mile Creek	6.8	-	EE-12	EE-12	1.6	-	5.2	12,800	78,000	850
566	Warland Creek	8.8	-	EE-12	EE-12	8.8	-	-	85,800	-	1,100
566A[3]	South spur	2.0	-	-	EE-12	-	-	2.0	-	13,000	180
596	Sullivan Creek	10.5									
	Road 92 to south line Section 15		8.0	E-14	EE-12	-	8.0	-	96,000	40,000	1,000
	South line Section 15 to road 470		2.5	-	EE-12	-	-	2.5	-	30,000	225
596A[3]	Boulder Creek connection	7.5	-	EE-12	EE-12	7.5	-	-	86,250	-	675
596B[3]	North spur	4.0	-	-	EE-12	-	-	4.0	-	60,000	360
615	Barron Creek	12.5									
	Forest Highway 57 to road 615A		8.0	EE-12	EE-12	8.0	-	-	66,000	-	1,000
	Road 615A to road 333		4.5	-	E-12	-	-	4.5	-	34,000	315
615A	Blue Mountain	4.5									
	Road 615 to Section 28, T32N, R30W		2.5	EE-12	EE-12	2.5	-	-	12,500	-	225
	Section 28 to Blue Mountain lookout		2.0	F-10	E-12	-	2.0	-	2,500	6,000	140
615B	North spur	4.2	-	F-12	EE-12	-	4.2	-	16,800	8,500	380
615C	South spur	4.5	-	F-12	EE-12	-	4.5	-	18,000	18,000	405
615D	South connection	3.4	-	F-10	EE-12	-	3.4	-	9,400	9,400	305
619	Sutton Creek	9.0	-	-	EE-12	-	-	9.0	-	121,500	1,125
619A[3]	Stonehill bridge and approaches	0.3	-	-	H-30 22 feet	-	-	0.3	-	170,000	1,200
619B[3]	Flat Creek	4.0	-	-	EE-12	-	-	4.0	-	48,000	360

Table 45. Status of principal existing and proposed roads within the Zone of Influence (Cont.)

Study O

Road number	Road name and termini of sections	Total length	Section length	Construction standard: Existing	Construction standard: Proposed	Status: Adequate	Status: Inadequate	Status: Non-existing	Replacement value (1951 index)	Cost to complete (1951 index)	Estimated annual maintenance cost of proposed standard
		- - Miles - -				- - - Miles - - -			- - - - - Dollars - - - - -		
751	Little North Fork	10.0									
	Road 336 to road 751A		6.0	-	DD-16	-	-	6.0	-	105,000	1,050
	Road 751A to road 470		4.0	-	EE-12	-	-	4.0	-	46,000	360
751A	Webb Mountain spur	4.1	-	-	E-12	-	-	4.1	-	27,060	290
753	South Fork Big Creek	19.0									
	Road 333A to road 526		5.7	-	E-12	-	-	5.7	-	58,000	400
	Road 526 to road 336		13.3	F-10	EE-12	-	1.0	12.3	7,000	141,450	1,660
753A	West branch spur	4.0	-	-	EE-12	-	-	4.0	-	46,000	360
758	Black Lake	5.6	-	F-10	E-12	-	5.6	-	11,000	17,000	390[2]
759	Libby - South Side Kootenai	13.6	-	DD-18	DD-18	13.6	-	-	569,000	-	2,720[2]
759A	Tony Peak	5.5	-	-	E-12	-	-	5.5	-	36,000	385
759B[3]	South spur	3.0	-	EE-12	EE-12	3.0	-	-	22,500	-	210
760	Little Wolf Creek	9.0	-	EE-12	EE-12	1.5	1.5	6.0	13,000	37,500	810
761	Raven Creek	6.0									
	State Highway 2 to Section 34, T27N, R29W		3.0	-	EE-12	-	-	3.0	-	27,000	270
	Section 34 to Kenelty Mountain		3.0	-	E-12	-	-	3.0	-	15,000	210
762	Cow Creek	10.0									
	Road 232 to Section 14, T28N, R28W		7.0	-	EE-12	-	-	7.0	-	63,000	630
	Section 14 to Calx Mountain		3.0	-	E-12	-	-	3.0	-	13,500	210
763	West Side Fisher River	8.5	-	DD-16	DD-16	8.5	-	-	255,000	-	1,490[2]
763A	Buck Creek	5.0	-	EE-12	EE-12	5.0	-	-	42,500	-	450
764	Harris Creek	4.0	-	-	EE-12	-	-	4.0	-	36,000	360
765	Squaw Creek	4.0	-	-	EE-12	-	-	4.0	-	30,000	360
835	Cripple Horse Creek	17.8	-	EE-12	EE-12	12.8	2.0	3.0	114,000	30,000	2,225
835A	Wiegal lookout	4.5	-	-	E-12	-	-	4.5	-	20,500	315
835B[3]	North spur	2.0	-	-	EE-12	-	-	2.0	-	12,000	140
852	Green Basin	8.0									
	Road 494 to Section 11, T37N, R28W		1.5	EE-12	EE-12	1.5	-	-	11,400	-	135
	Section 11 to road 303		6.5	F-9	E-12	-	5.5	1.0	13,750	32,000	455
854	Othorp Lake	6.0	-	E-12	E-12	6.0	-	-	42,000	-	420
856	Upper Pinkham Creek	24.3	-	CC-20	CC-20	20.8	-	3.5	468,000	78,750	5,470
856A[3]	East Pinkham Creek	5.0									
	Road 856 to road 856B		2.0	DD-16	DD-16	2.0	-	-	27,000	-	350
	Road 856B to Section 27, T34N, R27W		3.0	-	EE-12	-	-	3.0	-	19,800	270
856B[3]	North spur	3.2	-	E-12	EE-12	-	3.2	-	15,000	4,800	290
856C[3]	South spur	2.0	-	E-12	EE-12	-	2.0	-	9,000	2,400	180
856D[3]	Lydia Creek	2.0	-	-	EE-12	-	-	2.0	-	21,000	180
856E[3]	Virginia Hill	3.4	-	E-12	EE-12	-	3.4	-	10,200	2,500	305
856F[3]	Rexford connection	2.5	-	F-10	E-12	-	2.5	-	6,300	7,500	175
859	Surprise Hill	5.5									
	Forest Highway 4 to Section 27, T29N, R27W		3.5	-	EE-12	-	-	3.5	-	35,000	315
	Section 27 to Surprise Hill lookout		2.0	-	E-12	-	-	2.0	-	9,000	140
860	Gold Creek	5.0	-	-	EE-12	-	-	5.0	-	45,000	450
860A[3]	South spur	2.0	-	-	EE-12	-	-	2.0	-	24,000	180
861	North Fork Big Creek	8.5									
	Road 336 to south line Section 7, T35N, R30W		6.0	-	EE-12	-	-	6.0	-	54,000	540
	South line Section 7 to road 470		2.5	-	E-12	-	-	2.5	-	11,250	175
863	East Side Ziegler Mountain	5.0	-	F-12	EE-12	-	5.0	-	22,500	37,500	450
868	Trail Creek	8.0	-	-	EE-12	-	-	8.0	-	60,000	720
869	Barren Peak	6.3	-	-	E-12	-	-	6.3	-	47,000	440
870	McGinnis Creek	11.5	-	E-12	EE-12	-	11.5	-	92,000	44,000	1,435
870A	Elk Creek	8.5	-	F-10	EE-12	-	2.5	6.0	5,500	63,000	765

Table 45. Status of principal existing and proposed roads within the Zone of Influence (Cont.)

Study O

Road number	Road name and termini of sections	Total length	Section length	Construction standard: Existing	Construction standard: Proposed	Status: Adequate	Status: Inadequate	Status: Non-existing	Replacement value (1951 index)	Cost to complete (1951 index)	Estimated annual maintenance cost of proposed standard
		Miles	Miles			Miles	Miles	Miles	Dollars	Dollars	Dollars
872	Cande Gulch	3.2	-	F-12	EE-12	-	3.2	-	14,500	8,000	290
872A	East spur	1.3	-	F-12	EE-12	-	1.3	-	6,000	4,000	115
1018	Tub Gulch	3.8	-	EE-12	EE-12	3.8	-	-	32,300	-	340
1018A	Middle Fork	1.4	-	EE-12	EE-12	1.4	-	-	11,900	-	125
1018B	South Fork	0.8	-	EE-12	EE-12	0.8	-	-	6,800	-	70
1032	Kennedy Gulch	1.2	-	EE-12	EE-12	1.2	-	-	9,000	-	110
Total	for forest development roads	996.3				201.9	346.2	448.2	4,709,190	9,228,010	98,640 15,230 2/

1/ FHP - Forest Highway Project; FAP - Federal Highway Project.
2/ County and private roads.
3/ Not now on forest development road system.

highway bridge at Rexford with a structure having a 26-foot roadway designed for H20-S16 loading, is necessary in the development of an adequate transportation system in the absence of a dam. Despite its present deficiencies, the highway has a good valley bottom location from the standpoint of alignment. It has an excellent grade and is on favorable construction terrain for most of its length. It would require a minimum movement of material to make it a fully improved route. These advantages are reflected in the $2,175,000 cost estimate for the 45.9-mile reconstruction job.

Postdam transportation planning problem

Construction of a dam at River Mile 204.9 (about 2.5 miles upstream from Libby) and the impoundment of some 380 feet of water behind the dam to elevation 2459 would create a reservoir extending 65 miles to the Canadian border, and approximately 42 miles into Canada. For most of its length within the United States, the reservoir width would vary from 3/4 mile to 1 mile. The Great Northern Railway, State Highway 37, the valley bottom roads on the south and east sides of the Kootenai River above the dam (Nos. 759, 531, and 565), and the valley bottom roads on the east and west banks of the Fisher River to the mouth of Wolf Creek (Nos. 763 and F.H. 4) would be inundated. Briefly, the transportation planning problem is to determine the most economical way the services given by the facilities which would be invalidated could be restored so as to have as little adverse effect on the economy of Lincoln County as reasonably possible.

The reservoir would force road locations up to a minimum elevation of 2500 feet, varying from 420 feet above the valley floor near the dam to 220 feet above in the vicinity of Rexford. However, the road construction problem would not be greatly different if the location were only 50 feet above the valley floor. From Rexford south, the Kootenai River flows through a rock canyon with walls of 50- to 80-percent side slopes up to elevations 5000 and 6000 feet. In the few sections along the canyon walls where it is not exposed, the bedrock is overlain on generally 60-percent slopes with a clay silt material, deposited during a prehistoric lake period. These slopes would create a serious slide problem once the reservoir were in operation. Because this condition is particularly prevalent along the south bank of the Kootenai and the west bank of the Fisher, no road restorations are proposed in these locations. Even without the effect of reservoir saturation and drawdown, the silt banks are causing difficult maintenance problems along the Great Northern Railway, the south side Kootenai road, and the east and west side Fisher River roads (figure 34).

The potential seriousness of slides adjacent to reservoirs subjected to heavy drawdown is illustrated by figure 35. This slide occurred on the west bank of the Grand Coulee Dam Reservoir (Lake Roosevelt), about 5 miles south of Kettle Falls, Washington, in the winter of 1951-52 when the reservoir was drawn down a maximum of 65 feet. At the time the photograph was taken in April 1952, the slide area covered about 25 acres to a depth of 200 feet. The slide severed a county road, the original construction of which was a reservoir restoration project. This road can be seen in the photograph.

Figure 34. Slide area at Mile 16.0 on the west side of Fisher River road 763. Situations such as this may be expected to become aggravated with the establishment of a reservoir.

Figure 35. A huge slide area on the reservoir behind Coulee Dam.

Above the floor of the Kootenai River valley the canyon walls are broken by numerous and deep side drainages requiring extensive cuts and fills for satisfactory road alignment. All of these factors contribute to difficult, expensive road construction. They require careful appraisal of services against costs for any proposed road or even section of road.

Restoration of the transportation services and availability of the reservoir require consideration of water transportation possibilities. However, page 109, points out the impracticability of using the Libby dam reservoir for more than 6 or 7 months of the year. Even a 6- or 7-month use requires the employment of specialized, expensive equipment to handle economically logs or pulpwood into and out of the water for a drawdown range of as much as 60 feet.

The location of the railroad is another factor which must be considered in planning the restoration of transportation facilities. We have assumed that the Great Northern Railway would be relocated from a point near Libby, around the south end of the reservoir to the mouth of Wolf Creek on the Fisher River, up Wolf Creek, and down Fortine Creek to rejoin the existing location near Stryker, 22 railroad miles southeast of Eureka. (See transportation planning maps of Studies 1, 2, and 3.) Assuming that the existing railroad from Stryker to Eureka would be maintained and operated as a spur, Eureka can be considered as an outlet to Libby via rail for such portion of the timber from the Zone of Influence as would most economically move by that method under postdam conditions. Although the advantages of rail transportation would be lost to Kootenai River timber tributary to the Warland, Rexford, and proposed Stonehill sidings, the timber stands in the Wolf Creek and Fisher River drainages would benefit as a result of the postdam relocation of the railroad through that area.

One of the most important requirements of a postdam transportation system is economical winter transportation from areas which can be logged in the winter. One big reason why the existing manufacturing plant at Libby has been successful is that it has developed a yearlong logging operation. The existing transportation network permits an uninterrupted flow of logs from woods to mill throughout the entire year except for about one month when truck haul is prohibited by the reduction in bearing capacity of the roads during the spring thaw.

These transportation possibilities--road, water, and rail--and the required services to national forest protection, administration, and utilization, and to public travel needs, must be welded into an integrated transportation system. The objectives of the transportation planning can be summarized as follows:

1. Provide for adequate protection and administration of Zone of Influence area.

2. Provide access to timber stands for management and harvesting.

3. Provide mainline transportation system for carrying wood products from forests to mill with minimum practical adverse effect on total procurement costs (this requires particular consideration to continued accessibility of winter logging areas).

4. Provide for local and through public travel from Libby to Eureka.

5. Provide system having minimum adverse effect on other national forest resources and public uses of area.

Approach to solution of the transportation planning problem

A number of solutions can be proposed which would satisfy the foregoing objectives considered individually and without reference to the total cost. If the objectives are considered collectively, with the aim of minimizing the total cost of transportation restorations, the possible solutions are relatively few.

To determine which of the solutions would result in the least adverse effect per dollar of cost, three postdam transportation systems have been analyzed. As compared to the basic operating costs of the Study 0 transportation system, all three postdam systems have inadequacies which cannot be resolved at any reasonable cost. By comparing the estimated costs incurred under each with the Study 0 system, their relative adequacy is measured.

Study 1 is a transportation system providing low-standard, high-elevation, and consequently low-cost roads, which are reasonably adequate for fire protection only. The transportation of forest products tributary to the reservoir would be done principally by water and the cost of adequate water handling facilities is included in the total estimated cost of the system. The replacement of Highway 37 is routed via Fisher River and Five Mile Creek, the cheapest direct route between Libby and Eureka if its value to other uses is disregarded. The Study 1 system is designed principally to determine the effect of a major reliance on the cheapest method of restoring transportation facilities, with no regard to the resultant seasonal delivery of logs.

Study 2 transportation system relocates the Study 1 roads generally along the reservoir faces where they are of greater service to yearlong log transportation and of greater value for fire protection. Maximum use of water transportation for summer logs is made where it is the cheapest method, but in this plan practically all winter logs tributary to the reservoir would be transported to Libby by truck. Highway 37 is routed in the same location as in Study 1.

Study 3 is the next logical development of the transportation system in which the Highway 37 relocation is integrated with the log haul and protection road on the west side of the reservoir (the most favorable side from the standpoint of construction cost and service to resources). A bridge crossing is planned near the upper end of the reservoir over which Highway 37 would be routed to Eureka. The Study 3 system allows yearlong transportation of logs to Libby, but

is more favorable than Study 2 since winter logs from the north end of the reservoir on the west side can be trucked across the reservoir bridge to Eureka for reload onto rail. Again use is made of water for transportation of summer logs to the extent that it is cheaper than any other possible method. The cost of equipment to handle logs into the water at one permanent dump location, and for lifting them out of the water near the proposed dam, is included in the total estimated cost of the transportation system. As compared to Studies 1 and 2, the highway route of Study 3 is considerably shorter with resultant travel cost savings to highway users.

Road costs--postdam transportation system

In planning for the roads in Studies 1, 2, and 3 road standards were chosen which for the most part would result in the lowest total annual cost of construction plus maintenance and vehicle operation during the first 33-1/3 years of life of the roads.

In certain instances, however, we have departed from this criterion to select the minimum standard road which will adequately satisfy service requirements. These exceptions occur where high construction cost, incurred because the proposed reservoir forces the road location onto unfavorable terrain, upsets what might be considered a normal relationship between construction cost, maintenance cost, and vehicle operating costs. In all cases, the decision to recommend an exception is made only after weighing the comparative effects on total road and transportation costs.

The road standards on which construction costs of the various road routes and sections of road have been estimated are given in table 46 and figure 36.

Itemized road construction cost estimates for the principal routes considered in Studies 1, 2, and 3 are shown in table 47. Not included in that table are the E-12 "high line" protection road routes of Study 1 on the west side of the Kootenai River from Bristow Creek to the mouth of Parsnip Creek or on the east side of the Kootenai from the head of Five Mile Creek to the mouth of Sutton Creek.

For the principal routes (except the Route P protection system on McMillan Divide to Tony Peak) quantity estimates were made on the basis of a BB-30 construction standard. Appropriate percentages of the BB-30 quantities, determined from sample studies of typical sections along the reservoir face and in the generally more favorable construction topography back of the reservoir face, are applied in calculating estimated quantities of the lower standard roads. The BB-30 standard was not actually selected for any of the routes or sections of Studies 1, 2, or 3. However, at the time the road reconnaissance work was being conducted it was believed there would be justification for this standard, and for the use of "off-highway" logging trucks appropriate to this standard on certain sections of road. Consequently, quantity estimates for all principal routes were based on the BB-30 standard to insure a uniformity of estimates. However, the BB-28 construction

standard has subsequently been determined the maximum necessary in those areas where the use of "off-highway" equipment would be justified.

The use of "off-highway" trucks (that is trucks heavier when fully loaded than now permitted on state highways) is contemplated on certain sections of the planned road system. These trucks appear justified by the log transportation economies they would make possible. No harm need be done to the roads if they are built to carry heavy loads in the first place. However, before building these heavy-duty roads, an agreement should be reached with the State of Montana that such trucks would be permitted to use portions of the state highway constructed to carry them.

The quantity estimates given in table 47 are based on detailed reconnaissance trips by foot over the proposed route in which notes were made on percent of side slopes, type of clearing, percentage of solid rock and common excavation and the character of the rock, important drainage structures, either major culverts or bridges, and the necessity for guard rails. Depending on the extent to which side drainages and the topography affect the alignment of the road, appropriate percentage increases were made to the excavation quantities as determined from side slopes on the basis of a contour location. Percentage increases were also allowed to cover widening for curves and guard rail installation.

Along the reservoir faces, the road locations were established at a minimum elevation of 2500 feet, 41 feet above the maximum reservoir level. Within the gradient limitations for the standard of road considered, the locations were varied above this minimum elevation to take advantage of more favorable topography or to avoid areas of potential slides.

Locations selected in areas away from the reservoir (principally the Rainy Creek-Jackson Creek pass and the McMillan Creek-Doe Creek pass routes) have lower adverse haul gradients than the maximum allowed by road design standards. The grades could have been still lower; however, the roads would have been so much longer that the extra distance would have offset the economies of lesser grade.

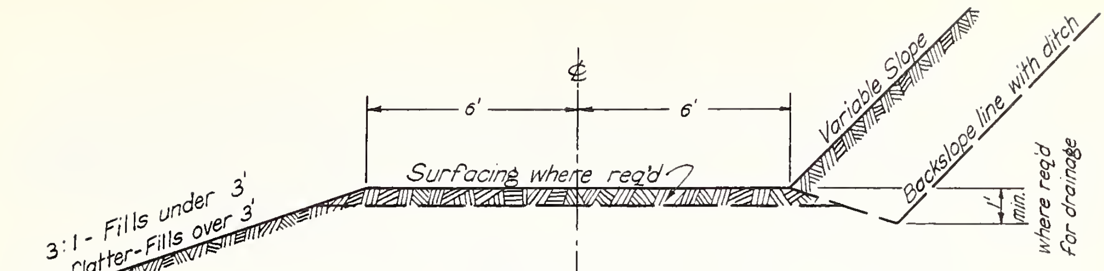
The unit price figures which are applied to the quantity estimates in determining the estimated cost of each standard of road are a composite of prices prevailing in 1951 on Montana-Idaho contract road construction of similar nature. The one item which should be explained is the use of $1.75 per cubic yard for solid rock excavation for the face routes on the west side of the reservoir, whereas a unit price of $1.90 is used on the east-side routes. The explanation is that on both sides of the Kootenai River the rock lays in strata which slope down toward the west. On the west side, rock breakage from blasting would be down toward the cut bank. On the east side, it would be down toward the outside shoulder, resulting in costly overbreaks difficult to control.

Table 46. Road design standards

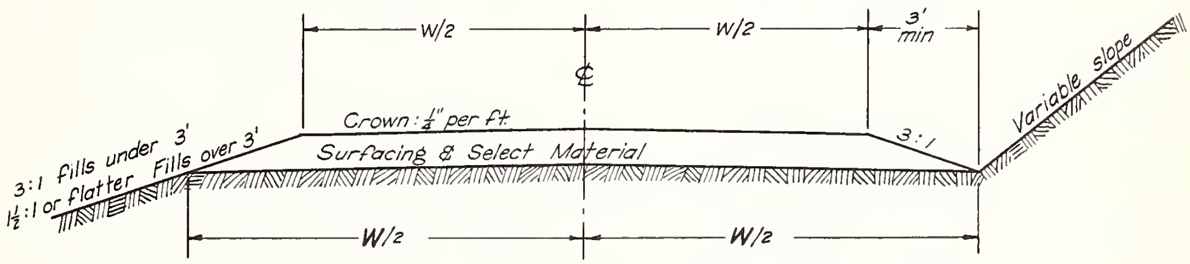
	Group I	Group II	Group III A	Group III B	Group IV A	Group IV B
	Protection road	Branch log haul and service road	Secondary log haul with light mixed traffic	Secondary log haul with moderate mixed traffic	Main log haul with heavy mixed traffic	"Off highway" log haul with heavy mixed traffic
Road class						
Surfaced width	E-12	EE-12	DD-16	CC-20	BB-24	BB-28
Design speed						
Miles per hour	15	20	25	30	40	40
Subgrade width for						
12-inch surfacing	-	-	22 feet	26 feet	32 feet	36 feet
8-inch surfacing	-	16 feet	-	-	-	-
Spot surfacing as required	14 feet	-	-	-	-	-
Turnouts[1]						
Surfaced width	22 feet	28 feet	28 feet	28 feet	-	-
Spacing, intervisible but not to exceed	1,000 feet	750 feet	750 feet	750 feet	-	-
Surface	Untreated except spot gravel	Crushed rock	Crushed rock	Crushed rock	Asphalt mat	Asphalt mat
Alignment						
Minimum radius	50 feet	100 feet	200 feet	200 feet	250 feet	250 feet
Minimum alignment factor (average radius divided by number of curves per mile)	-	50	75	75	100	100
Gradient, percent maximum						
Favorable, sustained	8	7	6	6	6	6
Favorable, pitch (not over 1000 feet in any one mile)	10	10	8	8	6	6
Adverse	8	4	4	4	4	4
Bridges						
A.A.S.H.O. loading[2]	H20 - S16	H30 - S24	H30 - S24	H30 - S24	H20 - S16	H30 - S24
Clear roadway width	14 feet	14 feet	22 feet	24 feet	26 feet	28 feet

1/Turnouts to be located on right side of road where practicable for empty trucks and all blind curves to be full turnout width.
2/American Association of State Highway Officials.

TYPICAL ROAD DESIGN SECTIONS

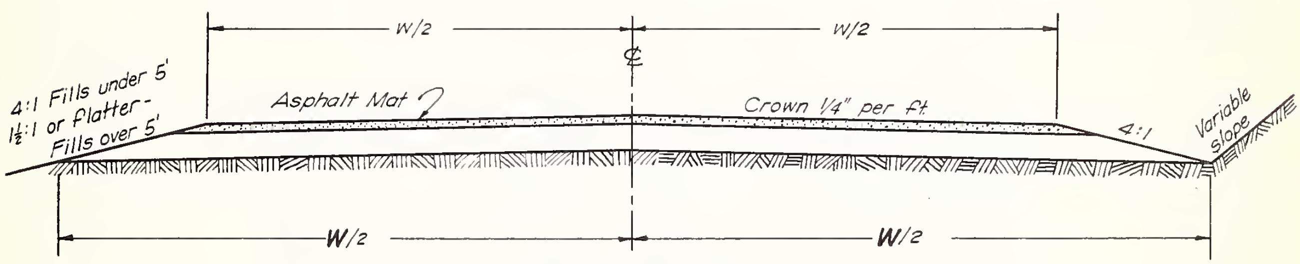


GROUP I ROAD
E 12



GROUP II & III ROADS

Standard	W	w
EE 12	16'	12'
DD 16	22'	16'
CC 20	26'	20'



GROUP IV ROADS

Standard	W	w
BB 24	32'	24'
BB 28	36'	28'

For all sections, add 1 ft to each fill side in design, staking and constructing rough grade to allow for settlement. Add extra foot when fill is over 6 ft high at shoulder.

In addition to these extra widths, all sections are to be widened for curvature as follows:

Radius	Extra width for curvature (one lane)
100 - 200	4.0'
200 - 300	3.5'
300 - 400	3.0'
400 - 500	2.5'
500 - 700	2.0'

Figure 36

Table 47. Details of road cost estimates

Clearing

Route and section	Length	Class of construction	BB-30 Quantity	BB-30 Cost per acre	BB-30 Total cost	BB-28 Percent of BB-30	BB-28 Total cost	BB-24 Percent of BB-30	BB-24 Total cost	CC-20 Percent of BB-30	CC-20 Total cost	DD-16 Percent of BB-30	DD-16 Total cost	EE-12 Percent of BB-30	EE-12 Total cost	E-12 Percent of BB-30	E-12 Total cost
	Miles		Acres	Dollars		Percent	Dollars	Percent	Dollars	Percent	Dollars	Percent	Dollars	Percent	Dollars	Percent	Dollars
Route E (Studies 1 and 2)																	
Section A	9.9	Light	96.2	500	48,100	-	-	80	38,480	67	32,227	53	25,493	40	19,240	-	-
		Medium	12.2	1000	12,200	-	-	80	9,760	67	8,174	53	6,466	40	4,880	-	-
Section B	9.6	Light	40.5	500	20,250	-	-	80	16,200	67	13,568	53	10,733	40	8,100	-	-
		Medium	76.5	1000	76,500	-	-	80	61,200	67	51,255	53	40,545	40	30,600	-	-
Section C	12.5	Light	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		Medium	148.6	1000	148,600	-	-	80	118,880	67	99,562	53	78,758	40	59,440	-	-
Section D-Alternate (Via face)	7.6	Light	29.8	500	14,900	-	-	80	11,920	67	9,983	53	7,897	40	5,960	-	-
		Medium	59.1	1000	59,100	-	-	80	47,280	67	39,597	53	31,323	40	23,640	-	-
Section D (Via Hi-line)	12.1	Light	47.9	500	23,950	-	-	80	19,160	67	16,047	53	12,694	40	9,580	-	-
		Medium	88.0	1000	88,000	-	-	80	70,400	67	58,960	53	46,640	40	35,200	-	-
Section E	6.0	Light	28.7	500	14,350	-	-	80	11,480	67	9,615	53	7,606	40	5,740	-	-
		Medium	35.0	1000	35,000	-	-	80	28,000	67	23,450	53	18,550	40	14,000	-	-
Section F	7.8	Light	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		Medium	97.1	1000	97,100	-	-	80	77,680	67	65,067	53	51,463	40	38,840	-	-
Section G	18.2	Light	91.0	500	45,500	-	-	80	36,400	67	30,486	53	24,116	40	18,200	-	-
		Medium	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Section H	4.5	Light	21.1	500	10,550	-	-	80	8,440	67	7,069	53	5,592	40	4,220	-	-
		Medium	31.2	1000	31,200	-	-	80	24,960	67	20,904	53	16,536	40	12,480	-	-
				E-12													
Route P (Studies 1, 2 & 3)																	
Section A	2.5	Light	3.85	500	1,925	-	-	-	-	-	-	-	-	-	-	-	-
		Medium	8.05	1000	8,050	-	-	-	-	-	-	-	-	-	-	-	-
Section B	3.5	Light	5.4	500	2,700	-	-	-	-	-	-	-	-	-	-	-	-
		Medium	11.25	1000	11,250	-	-	-	-	-	-	-	-	-	-	-	-
Section C	3.25	Light	5.0	500	2,500	-	-	-	-	-	-	-	-	-	-	-	-
		Medium	10.4	1000	10,400	-	-	-	-	-	-	-	-	-	-	-	-
				BB-30													
Route E (Study 3)																	
Section A	9.9	Light	96.2	500	48,100	-	-	80	38,480	67	32,227	53	25,493	40	19,240	-	-
		Medium	12.2	1000	12,200	-	-	80	9,760	67	8,174	53	6,466	40	4,880	-	-
Section B	9.6	Light	40.5	500	20,250	-	-	80	16,200	67	13,568	53	10,733	40	8,100	-	-
		Medium	76.5	1000	76,500	-	-	80	61,200	67	51,255	53	40,545	40	30,600	-	-
Section C	12.5	Light	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		Medium	148.6	1000	148,600	-	-	80	118,880	67	99,562	53	78,758	40	59,440	-	-
Section D (Via face)	7.6	Light	29.8	500	14,900	-	-	80	11,920	67	9,983	53	7,897	40	5,960	-	-
		Medium	59.1	1000	59,100	-	-	80	47,280	67	39,597	53	31,323	40	23,640	-	-
Section D-Alternate (Via Hi-line)	12.1	Light	47.9	500	23,950	-	-	80	19,160	67	16,047	53	12,694	40	9,580	-	-
		Medium	88.0	1000	88,000	-	-	80	70,400	67	58,960	53	46,640	40	35,200	-	-
Section E	5.6	Light	26.8	500	13,400	-	-	80	10,720	67	8,978	53	7,102	40	5,360	-	-
		Medium	32.7	1000	32,700	-	-	80	26,160	67	21,909	53	17,331	40	13,080	-	-
Section F	4.5	Light	21.1	500	10,550	-	-	80	8,440	67	7,069	53	5,592	40	4,220	-	-
		Medium	31.2	1000	31,200	-	-	80	24,960	67	20,904	53	16,536	40	12,480	-	-
Section G	10.0	Light	33.8	500	16,900	-	-	-	-	67	11,323	53	8,957	40	6,760	35	5,915
		Medium	81.2	1000	81,200	-	-	-	-	67	54,404	53	43,036	40	32,480	35	28,420
Section H	5.1	Light	52.9	500	26,450	-	-	-	-	67	17,722	53	14,019	40	10,580	35	9,258
		Medium	8.3	1000	8,300	-	-	-	-	67	5,561	53	4,399	40	3,320	35	2,905
Section I	3.6	Light	39.9	500	19,950	-	-	80	15,960	67	13,367	53	10,574	40	7,980	-	-
		Medium	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Route S (Studies 1, 2 & 3)																	
Section A	1.9	Light	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		Medium	17.5	1000	17,500	94	16,450	80	14,000	-	-	-	-	-	-	-	-
Section B	1.0	Light	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		Medium	10.7	1000	10,700	94	10,058	80	8,560	-	-	-	-	-	-	-	-
Route W (Study 3)																	
Section A	2.2	Light	27.7	500	13,850	94	13,019	80	11,080	67	9,280	53	7,341	-	-	-	-
Section B	3.2	Light	40.4	500	20,200	94	18,988	80	16,160	67	13,534	53	10,706	-	-	-	-
Section C	1.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Section D	23.1	Light	56.4	500	28,200	94	26,508	80	22,560	67	18,894	53	14,946	-	-	-	-
		Medium	214.8	1000	214,800	94	201,912	80	171,840	67	143,916	53	113,844	-	-	-	-
Section E	10.8	Light	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		Medium	117.1	1000	117,100	94	110,074	80	93,680	67	78,457	53	62,063	-	-	-	-
Section F	8.2	Light	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		Medium	95.6	1000	95,600	94	89,864	80	76,480	67	64,052	53	50,668	-	-	-	-
Section G	8.0	Light	12.6	500	6,300	94	5,922	80	5,040	67	4,221	53	3,339	-	-	-	-
		Medium	81.1	1000	81,100	94	76,234	80	64,880	67	54,337	53	42,983	-	-	-	-
Section H	0.4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Section I	13.8	Light	81.0	500	40,500	94	38,070	80	32,400	67	27,135	53	21,465	-	-	-	-
		Medium	61.7	1000	61,700	94	57,998	80	49,360	67	41,339	53	32,701	-	-	-	-
Route W-A (Study 3) (Alternate to Sections C and D of Route W)	25.1	Light	9.9	500	4,950	94	4,653	80	3,960	67	3,317	53	2,624	-	-	-	-
		Medium	128.0	1000	128,000	94	120,320	80	102,400	67	85,760	53	67,840	-	-	-	-
Route W-N (Study 3)	7.5	Light	16.6	500	8,300	94	7,802	80	6,640	67	5,561	53	4,399	-	-	-	-
		Medium	74.7	1000	74,700	94	70,218	80	59,760	67	50,049	53	39,591	-	-	-	-

Table 47. Details of road cost estimates (Cont.)

Excavation

Route and section	Length	Class of construction	BB-30 Quantity	BB-30 Cost per Cu.Yd.	BB-30 Total cost	BB-28 Percent of BB-30	BB-28 Total cost	BB-24 Percent of BB-30	BB-24 Total cost	CC-20 Percent of BB-30	CC-20 Total cost	DD-16 Percent of BB-30	DD-16 Total cost	EE-12 Percent of DD-30	EE-12 Total cost	E-12 Percent of BB-30	E-12 Total cost
	Miles		Cubic yards	Dollars		Percent	Dollars	Percent	Dollars	Percent	Dollars	Percent	Dollars	Percent	Dollars	Percent	Dollars
Route E (Studies 1 and 2)																	
Section A	9.9	Solid rock	30,449	1.75	53,285	-	-	80	42,628	73	38,898	55.1	29,363	36.5	19,427	-	-
		Common	303,951	.70	212,766	-	-	80	170,213	73	155,319	55.1	117,245	36.5	77,574	-	-
Section B	9.6	Solid rock	204,816	1.75	358,428	-	-	79.5	285,074	66.7	239,200	46.8	167,680	32.9	117,992	-	-
		Common	592,329	.70	414,630	-	-	79.5	329,773	66.7	276,706	46.8	193,973	32.9	136,494	-	-
Section C	12.5	Solid rock	302,864	1.75	530,012	-	-	79.8	423,011	67.2	355,925	44.9	238,190	29.8	158,174	-	-
		Common	698,487	.70	488,941	-	-	79.8	390,231	67.2	328,343	44.9	219,733	29.8	145,917	-	-
Section D-Alternate (Via face)	7.6	Solid rock	383,611	1.90	728,861	-	-	79.8	581,272	66.2	482,300	44.0	320,468	29.7	216,619	-	-
		Common	333,513	.70	233,459	-	-	79.8	186,186	66.2	154,484	44.0	102,648	29.7	69,385	-	-
Section D (Via Hi-line)	12.1	Solid rock	225,029	1.75	393,801	-	-	79.9	314,785	63.9	251,624	43.3	170,611	28.2	111,009	-	-
		Common	493,744	.70	345,621	-	-	79.9	276,272	63.9	220,839	43.3	149,738	28.2	97,427	-	-
Section E	6.0	Solid rock	95,965	1.90	182,333	-	-	77.5	141,321	63.9	116,435	39.3	71,617	27.8	50,767	-	-
		Common	289,650	.70	202,755	-	-	77.5	157,149	63.9	129,476	39.3	79,638	27.8	56,452	-	-
Section F	7.8	Solid rock	286,589	1.75	501,530	-	-	79.5	398,943	66.2	332,005	45.8	229,916	32.6	163,549	-	-
		Common	414,099	.70	289,869	-	-	79.5	230,576	66.2	191,889	45.8	132,884	32.6	94,526	-	-
Section G	18.2	Solid rock	43,993	1.75	76,988	-	-	80	61,591	65	50,042	42	32,335	31	23,866	-	-
		Common	265,544	.70	185,881	-	-	80	148,706	65	120,823	27.8	51,736	20.5	38,186	-	-
Section H	4.5	Solid rock	527,432	1.90	1,002,121	-	-	79.6	797,759	66.8	669,151	42.9	430,181	29.7	297,867	-	-
		Common	138,526	.70	96,968	-	-	79.6	77,193	66.8	64,749	42.9	41,625	29.7	28,822	-	-
				E-12													
Route P (Studies 1, 2 & 3)																	
Section A	2.5	Solid rock	5,637	1.75	9,865	-	-	-	-	-	-	-	-	-	-	-	-
		Common	16,913	.70	11,839	-	-	-	-	-	-	-	-	-	-	-	-
Section B	3.5	Solid rock	7,891	1.75	13,810	-	-	-	-	-	-	-	-	-	-	-	-
		Common	23,673	.70	16,571	-	-	-	-	-	-	-	-	-	-	-	-
Section C	3.25	Solid rock	7,349	1.75	12,860	-	-	-	-	-	-	-	-	-	-	-	-
		Common	22,047	.70	15,433	-	-	-	-	-	-	-	-	-	-	-	-
				BB-30													
Route E (Study 3)																	
Section A	9.9	Solid rock	30,449	1.75	53,285	-	-	80	42,628	73	38,898	55.1	29,363	36.5	19,427	-	-
		Common	303,951	.70	212,766	-	-	80	170,213	73	155,319	55.1	117,245	36.5	77,574	-	-
Section B	9.6	Solid rock	204,816	1.75	358,428	-	-	79.5	285,074	66.7	239,200	46.8	167,680	32.9	117,992	-	-
		Common	592,329	.70	414,630	-	-	79.5	329,773	66.7	276,706	46.8	193,973	32.9	136,494	-	-
Section C	12.5	Solid rock	302,864	1.75	530,012	-	-	79.8	423,011	67.2	355,925	44.9	238,190	29.8	158,174	-	-
		Common	698,487	.70	488,941	-	-	79.8	390,231	67.2	328,343	44.9	219,733	29.8	145,917	-	-
Section D (Via face)	7.6	Solid rock	383,611	1.90	728,861	-	-	79.8	581,272	66.2	482,300	44.0	320,468	29.7	216,619	-	-
		Common	333,513	.70	233,459	-	-	79.8	186,186	66.2	154,484	44.0	102,648	29.7	69,385	-	-
Section D-Alternate (Via Hi-line)	12.1	Solid rock	225,029	1.75	393,801	-	-	79.9	314,785	63.9	251,624	43.3	170,611	28.2	111,009	-	-
		Common	493,744	.70	345,621	-	-	79.9	276,272	63.9	220,839	43.3	149,738	28.2	97,427	-	-
Section E	5.6	Solid rock	88,551	1.90	168,246	-	-	77.3	130,051	63.5	106,877	38.7	65,106	27.6	46,457	-	-
		Common	267,270	.70	187,089	-	-	77.3	144,616	63.5	118,848	38.7	72,398	27.6	51,661	-	-
Section F	4.5	Solid rock	527,432	1.90	1,002,121	-	-	79.6	797,759	66.8	669,151	42.9	430,181	29.7	297,867	-	-
		Common	138,526	.70	96,968	-	-	79.6	77,193	66.8	64,749	42.9	41,625	29.7	28,822	-	-
Section G	10.0	Solid rock	1,025,462	1.90	1,948,378	-	-	-	-	65.1	1,268,545	43.8	853,668	30	585,438	14.5	282,966
		Common	393,814	.70	275,670	-	-	-	-	65.1	179,482	43.8	120,783	30	82,832	14.5	40,036
Section H	5.1	Solid rock	592,435	1.90	1,125,626	-	-	-	-	65.1	733,143	43.9	494,593	30.2	339,706	14.8	166,920
		Common	40,236	.70	28,165	-	-	-	-	65.1	18,344	43.9	12,375	30.2	8,500	14.8	4,177
Section I	3.6	Solid rock	550,144	1.90	1,045,273	-	-	79.6	832,493	66.4	694,338	43.2	451,590	30	313,365	-	-
		Common	45,744	.70	32,021	-	-	79.6	25,503	66.4	21,271	43.2	13,834	30	9,600	-	-
Route S (Studies 1, 2 & 3)																	
Section A	1.9	Solid rock	54,795	1.90	104,111	96.4	100,337	78.2	81,454	-	-	-	-	-	-	-	-
		Common	84,650	.70	59,255	96.4	57,107	78.2	46,359	-	-	-	-	-	-	-	-
Section B	1.0	Solid rock	18,795	1.90	35,710	96.4	34,435	78.3	27,963	-	-	-	-	-	-	-	-
		Common	70,409	.70	49,286	96.4	47,526	78.3	38,595	-	-	-	-	-	-	-	-
Route W (Study 3)																	
Section A	2.2	Solid rock	31,348	1.75	54,859	96.7	53,071	79.1	43,407	73.3	40,233	46.7	25,646	-	-	-	-
		Common	117,554	.70	82,288	96.7	79,607	79.1	65,110	73.3	60,349	46.7	38,468	-	-	-	-
Section B	3.2	Solid rock	258,696	1.75	452,718	96.3	435,865	79.8	361,215	68.1	308,345	45.9	207,791	-	-	-	-
		Common	162,294	.70	113,606	96.3	109,376	79.8	90,644	68.1	77,376	45.9	52,143	-	-	-	-
Section C	1.0	Common	7,100	.70	4,970	-	-	-	-	-	-	-	-	-	-	-	-
Section D	23.1	Solid rock	350,847	1.75	613,983	97.2	596,659	79.8	490,270	75.6	464,122	48.5	297,877	-	-	-	-
		Common	960,174	.70	672,122	97.2	653,158	79.8	536,694	75.6	508,070	48.5	326,084	-	-	-	-
Section E	10.8	Solid rock	976,958	1.75	1,709,676	96.3	1,645,823	79.6	1,361,136	67.3	1,150,907	45	769,189	-	-	-	-
		Common	663,514	.70	464,460	96.3	447,113	79.6	369,774	67.3	312,662	45	208,962	-	-	-	-
Section F	8.2	Solid rock	696,435	1.75	1,218,761	96.3	1,173,276	79.6	969,651	67.2	819,456	44.8	546,120	-	-	-	-
		Common	598,723	.70	419,106	96.3	403,465	79.6	333,443	67.2	281,794	44.8	137,799	-	-	-	-
Section G	8.0	Solid rock	883,924	1.75	1,546,867	96.3	1,489,226	79.9	1,235,389	66.1	1,022,094	45.6	705,907	-	-	-	-
		Common	309,627	.70	216,739	96.3	208,663	79.9	173,096	66.1	143,211	45.6	98,908	-	-	-	-
Section H	0.4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Section I	13.8	Solid rock	720,302	1.75	1,260,529	96.5	1,215,900	79.9	1,007,182	69.8	879,630	46.8	589,407	-	-	-	-
		Common	635,411	.70	444,788	96.5	429,040	79.9	355,392	69.8	310,385	46.8	207,977	-	-	-	-
Route W-A (Study 3) (Alternate to Sections C and D of Route W)	25.1	Solid rock	1,273,149	1.75	2,228,010	96.4	2,146,761	79.4	1,769,333	69.1	1,540,636	45.6	1,016,061	-	-	-	-
		Common	1,081,690	.70	757,183	96.4	729,570	79.4	601,302	69.1	523,581	45.6	345,305	-	-	-	-
Route W-N (Study 3)	7.5	Solid rock	429,008	1.75	750,764	-	724,224	-	598,834	-	518,352	-	344,670	-	-	-	-
		Common	375,139	.70	262,597	-	253,314	-	209,456	-	181,305	-	120,556	-	-	-	-

Table 47. Details of road cost estimates (Cont.)

Culverts

Route and section	Length	Size	SB-30 Quantity	SB-30 Cost per Lin.Ft.	SB-30 Total cost	SB-28 Percent of SB-30	SB-28 Total cost	SB-24 Percent of SB-30	SB-24 Total cost	CC-20 Percent of SB-30	CC-20 Total cost	DD-16 Percent of SB-30	DD-16 Total cost	EE-12 Percent of SB-30	EE-12 Total cost	E-12 Percent of SB-30	E-12 Total cost
	Miles	Inches	Linear Feet	Dollars		Percent	Dollars	Percent	Dollars	Percent	Dollars	Percent	Dollars	Percent	Dollars	Percent	Dollars
Route E (Studies 1 and 2)																	
Section A	9.9	18	4,400	5.00	22,000	-	-	80	17,600	67	14,740	53	11,660	40	8,800	-	-
		24	120	7.50	900	-	-	80	720	67	603	53	477	40	360	-	-
		36	160	13.50	2,160	-	-	80	1,728	67	1,447	53	1,145	40	864	-	-
		48	70	22.50	1,575	-	-	80	1,260	67	1,055	53	835	40	630	-	-
Section B	9.6	18	4,200	5.00	21,000	-	-	80	16,800	67	14,070	53	11,130	40	8,400	-	-
		24	210	7.50	1,575	-	-	80	1,260	67	1,055	53	835	40	630	-	-
		36	140	13.50	1,890	-	-	80	1,512	67	1,266	53	1,002	40	756	-	-
		48	110	22.50	2,475	-	-	80	1,980	67	1,658	53	1,312	40	990	-	-
		72	102	48.00	4,896	-	-	80	3,917	67	3,280	53	2,595	40	1,958	-	-
Section C	12.5	18	6,280	5.00	31,400	-	-	80	25,120	67	21,038	53	16,642	40	12,560	-	-
		36	70	13.50	945	-	-	80	756	67	633	53	501	40	378	-	-
		48	210	22.50	4,725	-	-	80	3,780	67	3,166	53	2,504	40	1,890	-	-
Section D-Alternate (Via face)	7.6	18	4,400	5.00	22,000	-	-	80	17,600	67	14,740	53	11,660	40	8,800	-	-
		72	260	48.00	12,480	-	-	80	9,984	67	8,362	53	6,614	40	4,992	-	-
Section D (Via Hi-line)	12.1	18	7,210	5.00	36,050	-	-	80	28,840	67	24,154	53	19,107	40	14,420	-	-
		72	176	48.00	8,448	-	-	80	6,758	67	5,660	53	4,477	40	3,379	-	-
Section E	6.0	18	2,900	5.00	14,500	-	-	80	11,600	67	9,715	53	7,685	40	5,800	-	-
		60	150	35.00	5,250	-	-	80	4,200	67	3,518	53	2,783	40	2,100	-	-
		72	150	48.00	7,200	-	-	80	5,760	67	4,824	53	3,816	40	2,880	-	-
Section F	7.8	18	3,360	5.00	16,800	-	-	80	13,440	67	11,256	53	8,904	40	6,720	-	-
		36	140	13.50	1,890	-	-	80	1,512	67	1,266	53	1,002	40	756	-	-
Section G	18.2	18	4,000	5.00	20,000	-	-	80	16,000	67	12,601	var.	2,849	var.	2,150	-	-
Section H	4.5	18	2,150	5.00	10,750	-	-	80	8,600	67	7,203	53	5,698	40	4,300	-	-
		36	250	13.50	3,375	-	-	80	2,700	67	2,261	53	1,789	40	1,350	-	-
		72	300	48.00	14,400	-	-	80	11,520	67	9,648	53	8,632	40	5,760	-	-
			E-12														
Route P (Studies 1,2 & 3)																	
Section A	2.5	18	540	5.00	2,700	-	-	-	-	-	-	-	-	-	-	-	-
Section B	3.5	18	760	5.00	3,800	-	-	-	-	-	-	-	-	-	-	-	-
Section C	3.25	18	700	5.00	3,500	-	-	-	-	-	-	-	-	-	-	-	-
			SB-30														
Route E (Study 3)																	
Section A	9.9	18	4,400	5.00	22,000	-	-	80	17,600	67	14,740	53	11,660	40	8,800	-	-
		24	120	7.50	900	-	-	80	720	67	603	53	477	40	360	-	-
		36	160	13.50	2,160	-	-	80	1,728	67	1,447	53	1,145	40	864	-	-
		48	70	22.50	1,575	-	-	80	1,260	67	1,055	53	835	40	630	-	-
Section B	9.6	18	4,200	5.00	21,000	-	-	80	16,800	67	14,070	53	11,130	40	8,400	-	-
		24	210	7.50	1,575	-	-	80	1,260	67	1,055	53	835	40	630	-	-
		36	140	13.50	1,890	--	-	80	1,512	67	1,266	53	1,002	40	756	-	-
		48	110	22.50	2,475	-	-	80	1,980	67	1,658	53	1,312	40	990	-	-
		72	102	48.00	4,896	-	-	80	3,917	67	3,280	53	2,595	40	1,958	-	-
Section C	12.5	18	6,280	5.00	31,400	-	-	80	25,120	67	21,038	53	16,642	40	12,560	-	-
		36	70	13.50	945	-	-	80	756	67	633	53	501	40	378	-	-
		48	210	22.50	4,725	-	-	80	3,780	67	3,166	53	2,504	40	1,890	-	-
Section D (Via face)	7.6	18	4,400	5.00	22,000	-	-	80	17,600	67	14,740	53	11,660	40	8,800	-	-
		72	260	48.00	12,480	-	-	80	9,984	67	8,362	53	6,614	40	4,992	-	-
Section D-Alternate (Via Hi-line)	12.1	18	7,210	5.00	36,050	-	-	80	28,840	67	24,154	53	19,107	40	14,420	-	-
		72	176	48.00	8,448	-	-	80	6,758	67	5,660	53	4,477	40	3,379	-	-
Section E	5.6	18	2,710	5.00	13,550	-	-	80	10,840	67	9,079	53	7,182	40	5,420	-	-
		60	150	35.00	5,250	-	-	80	4,200	67	3,518	53	2,783	40	2,100	-	-
		72	150	48.00	7,200	-	-	80	5,760	67	4,824	53	3,816	40	2,880	-	-
Section F	4.5	18	2,150	5.00	10,750	-	-	80	8,600	67	7,203	53	5,698	40	4,300	-	-
		36	250	13.50	3,375	-	-	80	2,700	67	2,261	53	1,789	40	1,350.	-	-
		72	300	48.00	14,400	-	-	80	11,520	67	9,648	53	8,632	40	5,760	-	-
Section G	10.0	18	4,500	5.00	22,500	-	-	-	-	67	15,075	53	11,925	40	9,000	28	6,300
		24	180	7.50	1,350	-	-	-	-	67	905	53	716	40	540	35	473
		36	300	13.50	4,050	-	-	-	-	67	2,714	53	2,147	40	1,620	35	1,418
		48	100	22.50	2,250	-	-	-	-	67	1,508	53	1,193	40	900	35	788
Section H	5.1	18	2,250	5.00	11,250	-	-	-	-	67	7,538	53	5,963	40	4,500	28	3,150
		24	120	7.50	900	-	-	-	-	67	603	53	477	40	360	35	315
		36	180	13.50	2,430	-	-	-	-	67	1,628	53	1,288	40	972	35	851
		48	100	22.50	2,250	-	-	-	-	67	1,508	53	1,193	40	900	35	788
Section I	3.6	18	1,730	5.00	8,650	-	-	80	6,920	67	5,796	53	4,585	40	3,460	-	-
		60	150	35.00	5,250	-	-	80	4,200	67	3,518	53	2,783	40	2,100	-	-
Route S (Studies 1, 2 & 3)																	
Section A	1.9	18	950	5.00	4,750	94	4,465	80	3,800	-	-	-	-	-	-	-	-
Section B	1.0	18	475	5.00	2,375	94	2,233	80	1,900	-	-	-	-	-	-	-	-
Route W (Study 3)																	
Section A	2.2	18	1,200	5.00	6,000	94	5,640	80	4,800	67	4,000	53	3,180	-	-	-	-
Section B	3.2	18	1,540	5.00	7,700	94	7,238	80	6,160	67	5,159	53	4,081	-	-	-	-
Section C	1.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Section D	23.1	18	12,480	5.00	62,400	94	58,656	80	49,920	67	41,808	53	33,072	-	-	-	-
		24	280	7.50	2,100	94	1,974	80	1,680	67	1,407	53	1,113	-	-	-	-
		36	120	13.50	1,620	94	1,523	80	1,296	67	1,085	53	859	-	-	-	-
		48	414	22.50	9,315	94	8,756	80	7,452	67	6,241	53	4,937	-	-	-	-
		72	140	48.00	6,720	94	6,317	80	5,376	67	4,502	53	3,562	-	-	-	-
Section E	10.8	18	5,150	5.00	25,750	94	24,205	80	20,600	67	17,253	53	13,648	-	-	-	-
		36	120	12.75	1,530	94	1,438	80	1,224	67	1,025	53	811	-	-	-	-
		60	200	35.00	7,000	94	6,580	80	5,600	67	4,690	53	3,710	-	-	-	-
		72	200	48.00	9,600	94	9,024	80	7,680	67	6,432	53	5,088	-	-	-	-
Section F	8.2	18	4,850	5.00	24,250	94	22,795	80	19,400	67	16,248	53	12,853	-	-	-	-
		36	120	12.75	1,530	94	1,438	80	1,224	67	1,025	53	811	-	-	-	-
		72	200	48.00	9,600	94	9,024	80	7,680	67	6,432	53	5,088	-	-	-	-
Section G	8.0	18	3,820	5.00	19,100	94	17,954	80	15,280	67	12,797	53	10,123	-	-	-	-
		36	180	12.75	2,295	94	2,157	80	1,836	67	1,538	53	1,216	-	-	-	-
Section H	0.4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Section I	13.8	18	6,600	5.00	33,000	94	31,020	80	26,400	67	22,110	53	17,490	-	-	-	-
		24	210	7.50	1,575	94	1,481	80	1,260	67	1,055	53	835	-	-	-	-
		36	140	13.50	1,890	94	1,777	80	1,512	67	1,266	53	1,002	-	-	-	-
Route W-A (Study 3) (Alternate to Sections C and D of Route W)	25.1	18	12,100	5.00	60,500	94	56,870	80	48,400	67	40,535	53	32,065	-	-	-	-
		36	360	13.50	4,860	94	4,568	80	3,888	67	3,256	53	2,576	-	-	-	-
		48	120	22.50	2,700	94	2,538	80	2,160	67	1,809	53	1,431	-	-	-	-
		60	300	35.00	10,500	94	9,870	80	8,400	67	7,035	53	5,565	-	-	-	-
Route W-N (Study 3)	7.5	18	4,570	5.00	22,850	94	21,479	80	18,280	67	15,310	53	12,111	-	-	-	-
		24	60	7.50	450	94	423	80	360	67	302	53	239	-	-	-	-
		72	136	48.00	6,528	94	6,136	80	5,222	67	4,374	53	3,460	-	-	-	-

Table 47. Details of road cost estimates (Cont.)

Bridges

Route and section	Length	Location	BB-30 Quantity	BB-30 Cost per Lin.Ft.	BB-30 Total cost	BB-28 Percent of BB-30	BB-28 Total cost	BB-24 Percent of BB-30	BB-24 Total cost	CC-20 Percent of BB-30	CC-20 Total cost	DD-16 Percent of BB-30	DD-16 Total cost	EE-12 Percent of DB-30	EE-12 Total cost	E-12 Percent of BB-30	E-12 Total cost
	Miles		Linear Feet	Dollars		Percent	Dollars	Percent	Dollars	Percent	Dollars	Percent	Dollars	Percent	Dollars	Percent	Dollars
Route E (Studies 1 end 2)																	
Section A	9.9	Libby Creek	60	450	27,000	-	-	80	21,600	65	17,550	45	12,150	32	8,640	-	-
Section B	9.6	Fisher River	100	450	45,000	-	-	80	36,000	65	29,250	45	20,250	32	14,400	-	-
Section C	12.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Section D-Alternate (Via face)	7.6	Cripple Horse Cliff	200	450	90,000	-	-	80	72,000	65	58,500	45	40,500	32	28,800	-	-
Section D (Via Hi-line)	12.1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Section E	6.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Section F	7.8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Section G	18.2	Swamp Creek	50	450	22,500	-	-	80	18,000	65	14,625	-	-	-	-	-	-
Section H	4.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Route P (Studies 1, 2 and 3)																	
Section A	2.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Section B	3.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Section C	3.25	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Route E (Study 3)																	
Section A	9.9	Libby Creek	60	450	27,000	-	-	80	21,600	65	17,550	45	12,150	32	8,640	-	-
Section B	9.6	Fisher River	100	450	45,000	-	-	80	36,000	65	29,250	45	20,250	32	14,400	-	-
Section C	12.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Section D (Via face)	7.6	Cripple Horse Cliff	200	450	90,000	-	-	80	72,000	65	58,500	45	40,500	32	28,800	-	-
Section D-Alternate (Via Hi-line)	12.1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Section E	5.6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Section F	4.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Section G	10.0	Ten Mile Creek	24	450	10,800	-	-	-	-	65	7,020	45	4,860	32	3,456	28	3,024
Section H	5.1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Section I	3.6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Route S (Studies 1, 2 & 3)																	
Section A	1.9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Section B	1.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Route W (Study 3)																	
Section A	2.2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Section B	3.2	Tub Gulch	450	450	202,500	96	194,400	80	162,000	65	131,625	45	91,125	-	-	-	-
Section C	1.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Section D	23.1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Section E	10.8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Section F	8.2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Section G	8.0	Big Creek	24	450	10,800	96	10,368	80	8,640	65	7,020	45	4,860	-	-	-	-
		NF Big Creek	16	450	7,200	96	6,912	80	5,760	65	4,680	45	3,240	-	-	-	-
Section H	0.4	Reservoir	2100	-	-		3,560,000	-	3,180,000	-	-	-	-	-	-	-	-
Section I	13.8	Pinkham Creek	300	450	135,000	96	129,600	80	108,000	65	87,750	45	60,750	-	-	-	-
Route W-A (Study 3) (Alternate to Sections C and D of Route W)	25.1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Route W-N (Study 3)	7.5	Boulder Creek	100	450	45,000	96	43,200	80	36,000	65	29,250	45	20,250	-	-	-	-

Table 47. Details of road cost estimates (Cont.)

Guard rails

Route and section	Length	Road standard: BB-30 Quantity	BB-30 Cost per mile	BB-30 Total cost	BB-28 Percent of BB-30	BB-28 Total cost	BB-24 Percent of BB-30	BB-24 Total cost	CC-20 Percent of BB-30	CC-20 Total cost	DD-16 Percent of BB-30	DD-16 Total cost	EE-12 Percent of BB-30	EE-12 Total cost	E-12 Percent of BB-30	E-12 Total cost
	Miles	Miles	Dollars		Percent	Dollars	Percent	Dollars	Percent	Dollars	Percent	Dollars	Percent	Dollars	Percent	Dollars
Route E (Studies 1 and 2)																
Section A	9.9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Section B	9.6	.75	24,000	18,000	-	-	100	18,000	100	18,000	100	18,000	50	9,000	-	-
Section C	12.5	.4	24,000	9,600	-	-	100	9,600	100	9,600	100	9,600	50	4,800	-	-
Section D-Alternate (Via face)	7.6	.5	24,000	12,000	-	-	100	12,000	100	12,000	100	12,000	50	6,000	-	-
Section D (Via Hi-line)	12.1	.1	24,000	2,400	-	-	100	2,400	100	2,400	100	2,400	50	1,200	-	-
Section E	6.0	2.0	24,000	48,000	-	-	100	48,000	100	48,000	100	48,000	50	24,000	-	-
Section F	7.8	.75	24,000	18,000	-	-	100	18,000	100	18,000	100	18,000	50	9,000	-	-
Section G	18.2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Section H	4.5	.9	24,000	21,600	-	-	100	21,600	100	21,600	100	21,600	50	10,800	-	-
Route P (Studies 1, 2 & 3)																
Section A	2.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Section B	3.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Section C	3.25	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Route E (Study 3)																
Section A	9.9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Section B	9.6	.75	24,000	18,000	-	-	100	18,000	100	18,000	100	18,000	50	9,000	-	-
Section C	12.5	.4	24,000	9,600	-	-	100	9,600	100	9,600	100	9,600	50	4,800	-	-
Section D (Via face)	7.6	.5	24,000	12,000	-	-	100	12,000	100	12,000	100	12,000	50	6,000	-	-
Section D-Alternate (Via Hi-line)	12.1	.1	24,000	2,400	-	-	100	2,400	100	2,400	100	2,400	50	1,200	-	-
Section E	5.6	2.0	24,000	48,000	-	-	100	48,000	100	48,000	100	48,000	50	24,000	-	-
Section F	4.5	.9	24,000	21,600	-	-	100	21,600	100	21,600	100	21,600	50	10,800	-	-
Section G	10.0	.8	24,000	19,200	-	-	-	-	100	19,200	100	19,200	50	9,600	-	-
Section H	5.1	.4	24,000	9,600	-	-	-	-	100	9,600	100	9,600	50	4,800	-	-
Section I	3.6	.8	24,000	19,200	-	-	100	19,200	100	19,200	100	19,200	50	9,600	-	-
Route S (Studies 1, 2 & 3)																
Section A	1.9	.6	24,000	14,400	100	14,400	100	14,400	-	-	-	-	-	-	-	-
Section B	1.0	.3	24,000	7,200	100	7,200	100	7,200	-	-	-	-	-	-	-	-
Route W (Study 3)																
Section A	2.2	.25	24,000	6,000	100	6,000	100	6,000	100	6,000	100	6,000	-	-	-	-
Section B	3.2	.25	24,000	6,000	100	6,000	100	6,000	100	6,000	100	6,000	-	-	-	-
Section C	1.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Section D	23.1	.4	24,000	9,600	100	9,600	100	9,600	100	9,600	100	9,600	-	-	-	-
Section E	10.8	1.75	24,000	42,000	100	42,000	100	42,000	100	42,000	100	42,000	-	-	-	-
Section F	8.2	1.5	24,000	36,000	100	36,000	100	36,000	100	36,000	100	36,000	-	-	-	-
Section G	8.0	.5	24,000	12,000	100	12,000	100	12,000	100	12,000	100	12,000	-	-	-	-
Section H	.4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Section I	13.8	.35	24,000	8,400	100	8,400	100	8,400	100	8,400	100	8,400	-	-	-	-
Route W-A (Study 3) (Alternate to Sections C and D of Route W)	25.1	3.65	24,000	87,600	100	87,600	100	87,600	100	87,600	100	87,600	-	-	-	-
Route W-N (Study 3)	7.5	.5	24,000	12,000	100	12,000	100	12,000	100	12,000	100	12,000	-	-	-	-

Table 47. Details of road cost estimates (Cont.)

Surfacing

Route and section	Length	BB-30 Quantity	BB-30 Cost per Cu.Yd.	BB-30 Total cost	BB-28 Percent of BB-30	BB-28 Total cost	BB-24 Percent of BB-30	BB-24 Total cost	CC-20 Percent of BB-30	CC-20 Total cost	DD-16 Percent of BB-30	DD-16 Total cost	EE-12 Percent of BB-30	EE-12 Total cost	F-12 Percent of BB-30	F-12 Total cost
	Miles	Cubic Yards	Dollars	Dollars	Percent	Dollars	Percent	Dollars	Percent	Dollars	Percent	Dollars	Percent	Dollars	Percent	Dollars
Route E (Studies 1 and 2)																
Section A	9.9	59,400	1.50	89,100	-	-	80	71,280	71	63,261	61	54,351	51	45,441	-	-
Section B	9.6	57,600	1.50	86,400	-	-	80	69,120	71	61,344	61	52,704	51	44,064	-	-
Section C	12.5	75,000	1.50	112,500	-	-	80	90,000	71	79,875	61	68,625	51	57,375	-	-
Section D-Alternate (Via face)	7.6	45,600	1.50	68,400	-	-	80	54,720	71	48,564	61	41,724	51	34,884	-	-
Section D (Via Hi-line)	12.1	72,600	1.50	108,900	-	-	80	87,120	71	77,319	61	66,429	51	55,539	-	-
Section E	6.0	36,000	1.50	54,000	-	-	80	43,200	71	38,340	61	32,940	51	27,540	-	-
Section F	7.8	46,800	1.50	70,200	-	-	80	56,160	71	49,842	61	42,822	51	35,802	-	-
Section G	18.2	109,200	1.50	163,800	-	-	80	131,040	71	116,298	61	99,918	51	83,538	-	-
Section H	4.5	27,000	1.50	40,500	-	-	80	32,400	71	28,755	61	24,705	51	20,655	-	-
			E-12													
Route P (Studies 1, 2 & 3)																
Section A.	2.5	-	$1000/Mi.	2,500	-	-	-	-	-	-	-	-	-	-	-	-
Section B	3.5	-	1000/Mi.	3,500	-	-	-	-	-	-	-	-	-	-	-	-
Section C	3.25	-	1000/Mi.	3,250	-	-	-	-	-	-	-	-	-	-	-	-
			BB-30													
Route E (Study 3)																
Section A	9.9	59,400	1.50	89,100	-	-	80	71,280	71	63,261	61	54,351	51	45,441	-	-
Section B	9.6	57,600	1.50	86,400	-	-	80	69,120	71	61,344	61	52,704	51	44,064	-	-
Section C	12.5	75,000	1.50	112,500	-	-	80	90,000	71	79,875	61	68,625	51	57,375	-	-
Section D (Via face)	7.6	45,600	1.50	68,400	-	-	80	54,720	71	48,564	61	41,724	51	34,884	-	-
Section D-Alternate (Via Hi-line)	12.1	72,600	1.50	108,900	-	-	80	87,120	71	77,319	61	66,429	51	55,539	-	-
Section E	5.6	33,600	1.50	50,400	-	-	80	40,320	71	35,784	61	30,744	51	25,704	-	-
Section F	4.5	27,000	1.50	40,500	-	-	80	32,400	71	28,755	61	24,705	51	20,655	-	-
Section G	10.0	60,000	1.50	90,000	-	-	-	-	71	63,900	61	54,900	51	45,900	25	22,500
Section H	5.1	30,600	1.50	45,900	-	-	-	-	71	32,589	61	27,999	51	23,409	25	11,475
Section I	3.6	21,600	1.50	32,400	-	-	80	25,920	71	23,004	61	19,764	51	16,524	-	-
Route S (Studies 1, 2 & 3)																
Section A	1.9	11,400	1.50	17,100	94	16,074	80	13,680	-	-	-	-	-	-	-	-
Section B	1.0	6,000	1.50	9,000	94	8,460	80	7,200	-	-	-	-	-	-	-	-
Route W (Study 3)																
Section A	2.2	13,200	1.50	19,800	94	18,612	80	15,840	71	14,058	61	12,078	-	-	-	-
Section B	3.2	19,200	1.50	28,800	94	27,072	80	23,040	71	20,448	61	17,568	-	-	-	-
Section C	1.0	3,509	1.50	5,264	96.2	5,066	-	-	-	-	-	-	-	-	-	-
Section D	23.1	138,600	1.50	207,900	94	195,426	80	166,320	71	147,609	61	126,819	-	-	-	-
Section E	10.8	64,800	1.50	97,200	94	91,368	80	77,760	71	69,012	61	59,292	-	-	-	-
Section F	8.2	49,200	1.50	73,800	94	69,372	80	59,040	71	52,398	61	45,018	-	-	-	-
Section G	8.0	48,000	1.50	72,000	94	67,680	80	57,600	71	51,120	61	43,920	-	-	-	-
Section H	0.4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Section I	13.8	82,800	1.50	124,200	94	116,748	80	99,360	71	88,182	61	75,762	-	-	-	-
Route W-A (Study 3) (Alternate to Sections C and D of Route W)	25.1	150,600	1.50	225,900	94	212,346	80	180,720	71	160,389	61	137,799	-	-	-	-
Route W-N (Study 3)	7.5	45,000	1.50	67,500	94	63,450	80	54,000	71	47,925	61	41,175	-	-	-	-

Table 47. Details of road cost estimates (Cont.)

Oiling

Route and section	Length	BB-30 Quantity	BB-30 Cost per Sq.Yd.	BB-30 Total cost	BB-28 Percent of BB-30	BB-28 Total cost	BB-24 Percent of BB-30	BB-24 Total cost	CC-20 Percent of BB-30	CC-20 Total cost	DD-16 Percent of BB-30	DD-16 Total cost	EE-12 Percent of BB-30	EE-12 Total cost	E-12 Percent of BB-30	E-12 Total cost
	Miles	Square Yard	Dollars		Percent	Dollars	Percent	Dollars	Percent	Dollars	Percent	Dollars	Percent	Dollars	Percent	Dollars
Route E (Studies 1 and 2)																
Section A	9.9	174,240	.60	104,544	-	-	80	83,635	37.9	39,585	-	-	-	-	-	-
Section B	9.6	168,960	.60	101,376	-	-	80	81,101	37.9	38,422	-	-	-	-	-	-
Section C	12.5	220,000	.60	132,000	-	-	80	105,600	37.9	50,028	-	-	-	-	-	-
Section D-Alternate (Via face)	7.6	133,760	.60	80,256	-	-	80	64,205	37.9	30,417	-	-	-	-	-	-
Section D (Via Hi-line)	12.1	212,960	.60	127,776	-	-	80	102,221	37.9	48,427	-	-	-	-	-	-
Section E	6.0	105,600	.60	63,360	-	-	80	50,688	37.9	24,013	-	-	-	-	-	-
Section F	7.8	137,280	.60	82,368	-	-	80	65,894	37.9	31,217	-	-	-	-	-	-
Section G	18.2	320,320	.60	192,192	-	-	80	153,753	37.9	72,841	-	-	-	-	-	-
Section H	4.5	79,200	.60	47,520	-	-	80	38,016	-	-	-	-	-	-	-	-
Route P (Studies 1, 2 & 3)																
Section A	2.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Section B	3.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Section C	3.25	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Route E (Study 3)																
Section A	9.9	174,240	.60	104,544	-	-	80	83,635	37.9	39,585	-	-	-	-	-	-
Section B	9.6	168,960	.60	101,376	-	-	80	81,101	37.9	38,422	-	-	-	-	-	-
Section C	12.5	220,000	.60	132,000	-	-	80	105,600	37.9	50,028	-	-	-	-	-	-
Section D (Via face)	7.6	133,760	.60	80,256	-	-	80	64,205	37.9	30,417	-	-	-	-	-	-
Section D-Alternate (Via Hi-line)	12.1	212,960	.60	127,776	-	-	80	102,221	37.9	48,427	-	-	-	-	-	-
Section E	5.6	98,560	.60	59,136	-	-	80	47,309	37.9	22,413	-	-	-	-	-	-
Section F	4.5	79,200	.60	47,520	-	-	80	38,016	-	-	-	-	-	-	-	-
Section G	10.0	176,000	.60	105,600	-	-	-	-	-	-	-	-	-	-	-	-
Section H	5.1	89,760	.60	53,856	-	-	-	-	-	-	-	-	-	-	-	-
Section I	3.6	63,360	.60	38,016	-	-	80	30,413	-	-	-	-	-	-	-	-
Route S (Studies 1, 2 & 3)																
Section A	1.9	33,440	.60	20,064	94	18,860	80	16,051	-	-	-	-	-	-	-	-
Section B	1.0	17,600	.60	10,560	94	9,926	80	8,448	-	-	-	-	-	-	-	-
Route W (Study 3)																
Section A	2.2	38,720	.60	23,232	94	21,838	80	18,586	-	-	-	-	-	-	-	-
Section B	3.2	56,400	.60	33,840	94	31,810	80	27,072	-	-	-	-	-	-	-	-
Section C	1.0	17,600	.60	10,560	94	9,926	-	-	-	-	-	-	-	-	-	-
Section D	23.1	406,560	.60	243,936	94	229,300	80	195,149	-	-	-	-	-	-	-	-
Section E	10.8	190,080	.60	114,048	94	107,205	80	91,238	-	-	-	-	-	-	-	-
Section F	8.2	144,320	.60	86,592	94	81,396	80	69,274	-	-	-	-	-	-	-	-
Section G	8.0	140,800	.60	84,480	94	79,411	80	67,584	-	-	-	-	-	-	-	-
Section H	.4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Section I	13.8	242,880	.60	145,728	94	136,984	80	116,582	-	-	-	-	-	-	-	-
Route W-A (Study 3) (Alternate to Sections C and D of Route W)	25.1	441,760	.60	265,056	94	249,153	80	212,045	-	-	-	-	-	-	-	-
Route W-N (Study 3)	7.5	132,000	.60	79,200	94	74,448	80	63,360	-	-	-	-	-	-	-	-

Table 47. Details of road cost estimates (Cont.)

Other

Route and section	Length	Engineering and Contingencies — Road standard BB-30	BB-28	BB-24	CC-20	DD-16	EE-12	E-12	General Administration — Road standard BB-30	BB-28	BB-24	CC-20	DD-16	EE-12	E-12
	Miles	Dollars	Dollars	Dollars	Dollars	Dollars	Dollars	Dollars	Dollars	Dollars	Dollars	Dollars	Dollars	Dollars	Dollars
Route E (Studies 1 and 2)															
Section A	9.9	68,836	-	55,068	44,743	31,102	22,303	-	32,123	-	25,699	20,880	14,514	10,408	-
Section B	9.6	138,290	-	110,632	89,889	62,491	44,806	-	64,536	-	51,628	41,948	29,163	20,910	-
Section C	12.5	175,047	-	140,037	113,780	76,146	52,864	-	81,688	-	65,351	53,098	35,535	24,670	-
Section D-Alternate (Via face)	7.6	158,575	-	126,860	103,074	68,980	47,890	-	74,002	-	59,201	48,101	32,191	22,348	-
Section D (Via Hi-line)	12.1	136,193	-	108,955	84,652	56,651	39,331	-	63,557	-	50,846	39,504	26,437	18,354	-
Section E	6.0	75,210	-	60,168	48,886	32,716	22,713	-	35,098	-	28,073	22,814	15,268	10,600	-
Section F	7.8	129,331	-	103,465	84,065	58,199	41,903	-	60,354	-	48,284	39,230	27,159	19,555	-
Section G	18.2	84,824	-	67,859	50,126	25,315	19,913	-	39,585	-	31,667	23,392	11,814	9,292	-
Section H	4.5	153,478	-	122,782	99,761	66,763	46,350	-	71,623	-	57,298	46,555	31,156	21,630	-
Route P (Studies 1, 2 & 3)															
Section A	2.5	-	-	-	-	-	-	4,426	-	-	-	-	-	-	2,065
Section B	3.5	-	-	-	-	-	-	6,196	-	-	-	-	-	-	2,891
Section C	3.25	-	-	-	-	-	-	5,753	-	-	-	-	-	-	2,685
Route E (Study 3)															
Section A	9.9	68,836	-	55,068	44,743	31,102	22,303	-	32,123	-	25,699	20,880	14,514	10,408	-
Section B	9.6	138,290	-	110,632	89,889	62,491	44,806	-	64,536	-	51,628	41,948	29,163	20,910	-
Section C	12.5	175,047	-	140,037	113,780	76,146	52,864	-	81,688	-	65,351	53,098	35,535	24,670	-
Section D (Via face)	7.6	158,575	-	126,860	103,074	68,980	47,890	-	74,002	-	59,201	48,101	32,191	22,348	-
Section D-Alternate (Via Hi-line)	12.1	136,193	-	108,955	84,652	56,651	39,331	-	63,557	-	50,846	39,504	26,437	18,354	-
Section E	5.6	70,196	-	56,157	45,628	30,535	21,199	-	32,758	-	26,207	21,293	14,250	9,893	-
Section F	4.5	153,478	-	122,782	99,761	66,763	46,350	-	71,623	-	57,298	46,555	31,156	21,630	-
Section G	10.0	309,348	-	-	194,889	134,566	93,423	47,021	144,362	-	-	90,948	62,798	43,597	21,943
Section H	5.1	157,767	-	-	99,388	68,629	47,646	23,981	73,625	-	-	46,431	32,027	22,235	11,191
Section I	3.6	144,091	-	115,273	93,659	62,680	43,516	-	67,243	-	53,794	43,708	29,251	20,507	-
Route S (Studies 1, 2 & 3)															
Section A	1.9	28,462	27,323	22,769	-	-	-	-	13,282	12,751	10,626	-	-	-	-
Section B	1.0	14,980	14,381	11,984	-	-	-	-	6,991	6,711	5,592	-	-	-	-
Route W (Study 3)															
Section A	2.2	24,723	23,735	19,779	16,070	11,126	-	-	11,538	11,076	9,230	7,499	5,192	-	-
Section B	3.2	103,844	99,690	83,075	67,498	46,730	-	-	48,460	46,522	38,768	31,499	21,807	-	-
Section C	1.0	2,495	2,395	-	-	-	-	-	1,164	1,118	-	-	-	-	-
Section D	23.1	248,724	238,775	198,979	161,670	111,926	-	-	116,071	111,428	92,857	75,446	52,232	-	-
Section E	10.8	310,604	298,180	248,483	201,892	139,772	-	-	144,948	139,150	115,959	94,216	65,227	-	-
Section F	8.2	235,829	226,396	188,663	153,289	106,123	-	-	110,053	105,651	88,043	71,535	49,524	-	-
Section G	8.0	247,066	237,183	197,653	157,562	111,180	-	-	115,297	110,685	92,238	73,529	51,884	-	-
Section H	0.4	-	425,000	380,000	-	-	-	-	-	195,000	180,000	-	-	-	-
Section I	13.8	270,877	260,042	216,702	176,070	121,895	-	-	126,409	121,353	101,127	82,166	56,884	-	-
Route W-A (Study 3) (Alternate to Sections C and D of Route W)	25.1	453,031	434,910	362,425	294,470	203,864	-	-	211,415	202,958	169,132	137,420	95,137	-	-
Route W-N (Study 3)	7.5	159,587	153,203	127,669	103,731	71,814	-	-	74,474	71,495	59,579	48,408	33,513	-	-

Table 47. Details of road cost estimates (Cont.)

Totals

Route and section	Length	Road standard						
		BB-30	BB-28	BB-24	CC-20	DD-16	DD-12	E-12
	Miles	Dollars	Dollars	Dollars	Dollars	Dollars	Dollars	Dollars
Route E (Studies 1 and 2)								
Section A	9.9	674,589	-	539,671	438,482	304,801	218,567	-
Section B	9.6	1,355,246	-	1,084,197	880,911	612,413	439,100	-
Section C	12.5	1,715,458	-	1,372,366	1,115,048	746,234	518,068	-
Section D-Alternate (Via face)	7.6	1,554,033	-	1,243,228	1,010,122	676,005	469,318	-
Section D (Via Hi-line)	12.1	1,334,696	-	1,067,757	829,586	555,184	385,439	-
Section E	6.0	737,056	-	589,644	479,086	320,619	222,592	-
Section F	7.8	1,267,442	-	1,013,954	823,837	570,349	410,651	-
Section G	18.2	831,270	-	665,016	491,234	248,083	195,145	-
Section H	4.5	1,504,085	-	1,203,268	977,656	654,277	454,234	-
Route P (Studies 1, 2 & 3)								
Section A	2.5	-	-	-	-	-	-	43,370
Section B	3.5	-	-	-	-	-	-	60,718
Section C	3.25	-	-	-	-	-	-	56,381
Route E (Study 3)								
Section A	9.9	674,589	-	539,671	438,482	304,801	218,567	-
Section B	9.6	1,355,246	-	1,084,197	880,911	612,413	439,100	-
Section C	12.5	1,715,458	-	1,372,366	1,115,048	746,234	518,068	-
Section D (Via face)	7.6	1,554,033	-	1,243,228	1,010,122	676,005	469,318	-
Section D-Alternate (Via Hi-line)	12.1	1,334,696	-	1,067,757	829,586	555,184	385,439	-
Section E	5.6	687,925	-	550,340	447,151	299,247	207,754	-
Section F	4.5	1,504,085	-	1,203,268	977,656	654,277	454,234	-
Section G	10.0	3,031,608	-	-	1,909,913	1,318,749	915,546	460,804
Section H	5.1	1,546,119	-	-	974,055	672,562	466,928	235,011
Section I	3.6	1,412,094	-	1,129,676	917,861	614,261	426,452	-
Route S (Studies 1, 2 & 3)								
Section A	1.9	278,924	267,767	223,139	-	-	-	-
Section B	1.0	46,802	140,930	117,442	-	-	-	-
Route W (Study 3)								
Section A	2.2	242,290	232,598	193,832	157,489	109,031	-	-
Section B	3.2	1,017,668	976,961	814,134	661,484	457,951	-	-
Section C	1.0	24,453	23,475	-	-	-	-	-
Section D	23.1	2,437,491	2,339,992	1,949,993	1,584,370	1,096,871	-	-
Section E	10.8	3,043,916	2,922,160	2,435,134	1,978,546	1,369,762	-	-
Section F	8.2	2,311,121	2,218,677	1,848,898	1,502,229	1,040,004	-	-
Section G	8.0	2,421,244	2,324,395	1,936,996	1,544,109	1,089,560	-	-
Section H	0.4	-	4,180,000	3,740,000	-	-	-	-
Section I	13.8	2,654,596	2,548,413	2,123,677	1,725,488	1,194,568	-	-
Route W-A (Study 3) (Alternate to Sections C and D of Route W)	25.1	4,439,705	4,262,117	3,551,765	2,885,808	1,997,867	-	-
Route W-N (Study 3)	7.5	1,563,950	1,501,392	1,251,160	1,016,567	703,778	-	-

As pointed out earlier, road standards, with a few exceptions, were selected which would result in the lowest total annual cost of (1) construction, (2) maintenance, and (3) vehicle operation over the first 33-1/3 years of the life of these roads. This period is customarily used in Forest Service transportation planning. The annual construction cost has been calculated as .0425 percent of the original cost.[13]

Annual maintenance cost estimates per mile are itemized under each transportation planning study. The big difference in maintenance cost is between low-elevation reservoir face routes and those routes located away from the reservoir which must pass over higher elevation summits where snow removal is a big problem. The maintenance rates used in these studies are intended to be realistic, and when snow removal is required to include an allowance for its companion item, sanding.

Vehicle operating cost is the third element of road and transportation costs. High standard roads cost more to construct and maintain, but vehicle operating costs are less. The postdam transportation studies have attempted to determine what routes are needed and, after that, what standard would result in the lowest cost of construction plus maintenance plus operation for all the vehicles that would use the road. Vehicle operating costs as used in these studies are shown in table 48.

The costs of sawlog transportation in table 48 for the various road standards are derived from the US Forest Service Region 1 publication, "Practical applications of log hauling cost data, 1948." The published cost data are increased by 35 percent to adjust them to the 1951 cost level.

The costs of pulpwood transportation are derived from the same data by applying as a factor the ratio of weight between a cord of pulpwood and 1000 board feet of sawlogs. In this case, a cord of pulpwood is assumed to weigh 4800 pounds and 1000 board feet of sawlogs to weigh 8000 pounds. Consequently, the ratio 4800 ÷ 8000 = 0.60, converts sawlog transportation cost per thousand board foot-mile to pulpwood transportation cost per cord-mile.

The tabulated costs of forest products transportation are the average for road gradients ranging from 1 percent adverse to 1 percent favorable. For road grades outside this range, these rates per thousand board foot-mile or per cord-mile are modified in accordance with the data given in "Practical applications of log hauling cost data."

13/ 1 ÷ 33.33 + .5 x .025 = .0425

Table 48. Vehicle operating costs

	Sawlogs 1/ Per thousand board foot-mile	Cordwood 1/ Per cord-mile	Recreational traffic 2/ Per vehicle-mile	Commercial and administrative traffic 2/ Per vehicle-mile
	Dollars			
Group I roads (15 MPH) (unimproved earth or spot surfaced) E-12	0.261	0.157	0.182	0.312
Group II roads (20 MPH) (crushed rock surface) EE-12	0.223	0.134	0.156	0.256
Group III A roads (25 MPH) (crushed rock surface) DD-16	0.189	0.113	0.130	0.210
Group III B roads (30 MPH) (crushed rock surface) CC-20	3/ 0.189	3/ 0.113	0.130	0.197
Group IV A roads (40 MPH) (asphalt mat surface) BB-24	0.142	0.085	0.104	0.154
Group IV B roads (40 MPH) (asphalt mat surface) BB-28	4/ 0.122	4/ 0.073	0.104	0.154

1/ Round trip, excluding delay time. 2/ One way.
3/ Same as costs for DD-16 since both standards are considered one lane for log haul.
4/ Less than costs for BB-24 since BB-28 standard allows use of "off-highway" equipment.

Recreational car operating costs are taken from the costs given in Oregon State Highway Department Technical Bulletin 7, "The Economics of Highway Planning," 1938 Edition, and adjusted for 1951 costs, as follows:

Mileage element costs

	Oregon State composite car	Factor of increase	1951 costs
	Cents a mile		Cents a mile
Gas, 20¢ a gallon	1.32	1.6	2.11
Oil, 25¢ a quart	0.19	1.4	0.27
Tires and tubes	0.23	1.6	0.37
Maintenance	0.56	1.6	0.90
Depreciation (two-thirds) based on 7000 miles a year	0.91	2.5	2.28
Total	3.21		5.93

Nonmileage element costs

	Dollars a year		Dollars a year
Depreciation (one-third)	32.20	2.5	80.50
License	5.00	3.0	15.00
Garage (storage only)	36.00	3.0	108.00
Interest (6 percent on 1/2 cost)	25.50	3.0	76.50
Insurance	10.00	3.0	30.00
Total	108.70		310.00

On the basis of 7000 miles a year, the nonmileage cost elements add 4.43 cents a mile to the mileage cost elements for a total of 10.36 cents a mile.

The above costs for operation of recreational cars are typical for modern highway surfaces. Data covering the effect of type of surfacing and road standard on costs are meager. However, such data as are available indicate that if Group IV roads with an asphalt mat or concrete surface and alignment factor of 100 are taken as 100 percent, the operating costs of recreational cars on other classes of roads would be as follows:

Group I - unimproved earth or spot surfaced	175 percent
Group II - alignment factor 50, compacted crushed rock	150 percent
Group III - alignment factor 75, compacted crushed rock	125 percent

These estimates are based on studies by Iowa State College[14/] and the Forest Service[15/].

14/ "Highway and Railway Economics," G. E. Hawthorn quoting Professor T. R. Agg of Iowa State College.

15/ 1939 Transportation Planning Instructions of the US Forest Service.

For the cost analyses of this report, no increases are calculated in vehicle operating costs for recreational or commercial traffic due to road gradients.[16]

With the above composite operating cost indices, the vehicle operating costs for recreational traffic may be established as $0.104 a mile for Group IV roads, $0.130 for Group III, $0.156 for Group II, and $0.182 for Group I.

Vehicle operating costs for commercial and administrative traffic are assumed to be the same as recreational car operating costs except for the addition of the driver's time at $16 per 8-hour day. On the 40-MPH Group IV roads, the driver's time adds $0.05 a mile to the recreational car operating costs, on the 30-MPH Group III B roads it adds $0.067 a mile, on the 25-MPH Group III A roads it adds $0.08 a mile, on the 20-MPH Group II roads it adds $0.10 a mile, and on the 15-MPH Group I roads it adds $0.13 a mile.

Traffic estimates

Traffic estimates for the purposes of the road cost analysis of this report are divided into five categories (1) timber haul--sawlogs and pulpwood, (2) mining haul, (3) recreational cars, (4) commercial cars and trucks, and (5) Forest Service administrative and protective traffic. The bases for estimating the amount of traffic in these categories in each of Studies 1, 2, and 3 are discussed in the following paragraphs.

The total annual cut of timber from each logging unit within the Zone of Influence is listed in table 43. The cut is shown by source; i.e., sawlogs, pulpwood from thinnings, or pulpwood from tops, cull and understory trees. It is also shown by volumes in summer and winter operating areas within the units. The analysis of timber production costs has resulted in a determination for each of Studies 1, 2, and 3 of the most economical method of transporting the timber production from each of these units to Libby. The results of that analysis are summarized on a schedule for each study, listing the timber volumes, and the transportation routing of each unit. These schedules are included in the transportation planning reports of each study. All logging units in the Zone of Influence, except units 92, 93, 95, and 96 are included in the "mode of transport" schedules. These four units are at the upper end of the Big Creek drainage from which they are most economically trucked to Libby by way of the Pipe Creek forest development road 68,

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16/As reported in Oregon State Highway Department Technical Bulletin 5, The Effect of Highway Design on Vehicle Speed and Fuel Consumption, "The increase in fuel consumption for this class of vehicle (average passenger car) is generally so small as to be negligible unless traffic is abnormally dense, and for this reason grade reductions below 6 percent can generally be justified only when there is or will be a considerable volume of heavy truck traffic."

outside the Zone of Influence road system. Application of the truck operating cost per thousand-board-foot-mile or per cord-mile to the annual cut volumes of the unit and to the miles of mainline roads between the unit and the destination of its timber results in the annual cost of timber transportation on the road.

The traffic estimates of mining haul are based entirely on the operations of the Zonolite Company. Each transportation planning study has assumed that the vermiculite concentrates of this company would be trucked to the nearest rail access at Libby over a road connecting the Rainy Creek road above flowline with existing State Highway 37 downstream from the dam. The annual concentrate production rate and the ton-mile haul cost, used in determining the annual cost of mine products transportation over this section of road, were furnished by the Zonolite Company.

The most important application of recreational traffic estimates is to the road route which would replace existing State Highway 37. The dam and reservoir would markedly change existing conditions and uses of the area. In addition to those recreationists who would make use of the lake area for summer homes, camping, boating, fishing, hunting, and scenic trips, a large diversion of east and west tourist travel from Highways 2 and 93 would be attracted to a scenic lake route. It is not unreasonable to anticipate that the postdam traffic increases between Libby and Eureka would encourage early betterment of the existing route in Canada, north of US Highway 93, to Banff National Park, Calgary, Edmonton, and its connection with the Alcan Highway. This betterment would, in turn, generate further increases in recreational traffic.

The estimates for the 1971 postdam recreational use of the replacement of State Highway 37 vary from 47,500 through cars a year in the location proposed by Studies 1 and 2, to 60,000 through cars a year in the shorter location proposed by Study 3. In Study 3 the location generally parallels the reservoir where it would be of greater attraction than the Study 1 and 2 location where it is completely away from the reservoir for most of its length. The 1951 traffic volumes on existing State Highway 37, as tabulated in Section 1 of this report, can be compared with these estimates in table 49.

Table 49. Present and estimated recreational traffic on State Highway 37 between Libby and Eureka

	Annual 24-hour average traffic	Annual traffic	Percent of 1951 passenger car traffic
1951 Montana and out-of-State passenger cars	62	22,630	-
Estimated 1971 recreational traffic via highway route of Studies 1 and 2	130	47,500	210
Estimated 1971 recreational traffic via highway route of Study 3	164	60,000	265

Sections at the ends of these proposed routes are credited with greater traffic volumes by reason of visitors to the dam itself, lake area recreationists, local hunters, fishermen, and campers who would not be included in the estimate of through traffic. Considering the likely growth in use of this area, the above estimates of recreational traffic are believed to be conservative.

The category, commercial cars and trucks, includes the type of traffic required in servicing logging and pulpwood operations and other local enterprises, farm pickups and trucks, and commercial travelers. It does not include the logging or mining trucks used for actual haul of forest or mine products. Estimates of the 1971 volumes of this traffic vary from 27,500 through vehicles a year on the highway route of Studies 1 and 2, to 40,000 through vehicles a year on the shorter highway route of Study 3. These estimates are compared with the 1951 traffic volumes on existing State Highway 37 in table 50.

Table 50. Present and estimated commercial car and truck traffic on Montana Highway 37 in Zone of Influence

	Annual 24-hour average traffic	Annual traffic	Percent of 1951 traffic
1951 commercial cars and trucks	41	14,965	-
Estimated 1971 traffic of commercial cars and trucks via highway route of Studies 1 and 2	75	27,500	184
Estimated 1971 traffic of commercial cars and trucks via highway route of Study 3	110	40,000	267

The percentage increases for the commercial traffic are of the same order allowed for the recreational traffic. As for the recreational traffic, a somewhat greater volume of traffic has been estimated near the ends of the highway routes to allow for local work trips in and out of Libby and Eureka.

Administrative and protective traffic includes all of the traffic incident to the administration, management, and protection of the national forest. The volume of travel in these categories is small in comparison with other types of traffic. However, their inclusion is necessary in weighing the service of the proposed road system to this vitally important job. The 1971 estimate of the volume of national forest traffic is shown in the road system cost analysis of each of Studies 1, 2, and 3. No separate count identifying the present amount of this traffic is available for comparison with the 1971 estimate.

Trail costs--postdam transportation system

The trail construction required by each of postdam transportation Studies 1, 2, and 3 is itemized and identified under each of the study reports. From purely the cost standpoint, the required trail construction would not be an important part of the transportation restoration job. Accordingly, no detailed cost estimates or discussions of the routes are presented in the individual transportation studies. This omission is not to be interpreted as minimizing the importance of the proposed trails. They would provide transportation to areas presently accessible by roads, for which road transportation cannot be justified after the dam because of high construction cost. The trails would be an integral part of the fire protection transportation system, affording three to five times faster travel by foot than cross-country travel without benefit of trails. They would also allow tools and supplies to be horse-packed to going fires from the end of road transportation. Even with the possible use of boat transportation to those areas not served by roads, paralleling trails are needed because there are relatively few places where boats could be landed.

The trail cost estimates are based on construction to a 24-inch tread width in accordance with the gradient, clearance, and stability specifications given in the US Forest Service Trail Handbook for all-purpose trails. The cost estimates allow for the fact that where the difficulty of construction prohibits justification of roads under the particular study, it would also be comparatively difficult and costly for trails.

Landing field costs--postdam transportation system

A new landing field would be needed no matter which of the three road plans was adopted. The field would be relocated at a site across the Kootenai River from Libby, on national forest land in Sections 28 and 27, T31N, R31W, at elevation 2320. The existing Pipe Creek forest development road 68 provides access to the site. The road, in fact, cuts across the east end of the proposed runway and would have to be relocated in part to avoid interferences with safe use of the field.

It is recommended that the proposed field be constructed to the Class 3 "Feeder" designation of the Civil Aeronautics Administration without paved runway, to permit transport planes of the 25,000-pound DC-3 Class to land as they do at the present field. This designation requires sea-level runway lengths of 3000 to 3500 feet, and minimum landing strip and runway widths of 300 and 100 feet, respectively. Assuming the runway could be laid out on a 0.0 percent gradient, the correction factors for elevation, and for mean temperature (70°) of the hottest month above the standard temperature (50.7°) for the site would actually require building a 4200-foot runway.

The existing field is constructed on ground containing considerable amounts of coarse material (the proposed source of aggregate for the dam construction), and consequently has good drainage and bearing capacity. In contrast, the proposed site has predominantly a clay-silt

soil with a negligible amount of coarse material. Although a paved runway is not proposed because the field is used by heavy planes only in the summer season, the construction cost estimate contemplates that it would be necessary to provide a minimum 9-inch base course of soil-aggregate mixture under the 100-foot runway width and that the entire landing strip width of 300 feet would be planted to a grass satisfactory for the site.

The estimated cost of the landing field restoration for one 300-foot wide east-west landing strip, 4200 feet long, cleared 500 feet wide, and with a 100-foot runway, is as follows:

Clearing and grubbing 15 acres at $250	$ 3,750
Excavation 50,000 cubic yards at $0.70	35,000
Base course 35,000 cubic yards at $1.50	52,500
Turf 140,000 square yards at $0.10	14,000
Fencing 10,000 lineal feet at $0.45	4,500
Markers, etc.	1,500
Relocation Pipe Creek road	70,775
Contingencies, engineering, administration	27,305
Total	$209,330

Water transportation costs--postdam transportation system

The reservoir could be used for log transportation and should be used for that purpose insofar as is feasible. With the dam at Mile 204.9, the reservoir when full would provide navigable waters on the Fisher River for 10 miles above the mouth. On the Kootenai River the reservoir would be navigable to the Canadian line, a distance of 65 miles. However, there are two important limitations which circumscribe the chances to use the reservoir: ice and drawdown.

Weather Bureau data for all years that records have been kept at the Libby station prior to and including 1944 indicate that low temperatures are common in this area during the winter months. The summarizations of these data follow:

Month	Average minimum	Average maximum	Average	Lowest of record
	- - - - - - Degrees	Farenheit - - - - - -		
October	31.5	60.2	45.8	- 7.0
November	25.0	42.0	33.5	-27.0
December	17.9	32.9	25.4	-38.0
January	13.5	31.6	22.6	-46.0
February	16.2	38.8	27.5	-37.0
March	23.6	49.9	36.8	-15.0

These figures indicate we may expect some ice formation from November through March. Records from other large bodies of water in the region support that conclusion. The Department of Interior reports that Jackson Lake, Wyoming freezes over between December 1 and 30 each year. Maximum thickness of 30 inches of ice occurred in 1941, whereas the minimum of 12 inches of solid ice occurred in 1943. On that lake ice disappears about May 10 each year, the earliest of record being April 19, and the latest of record being May 24.

The Canadian Department of Resources and Development reports that a 31-year record at Kaslo, B.C. shows they experience zero to subzero temperatures December to March, inclusive. A 41-year record at Revelstoke shows the same trend.

Lowest temperature on record--degrees Farenheit

	November	December	January	February	March
Kaslo, B.C.	+4	-12	-17	-15	0
Revelstoke	-6	-26	-30	-26	-6

That department reports that the Arrow Lakes narrow section near Burton freezes over during a part of most winters. The Kootenai River freezes over regularly down to the entrance to Kootenai Bay, and Okanagan Lake is subject to freezing over.

The Department of Interior reports that ice, except for a thin sheet, seldom forms close in above Coulee Dam structure. However, in 1948-49, 1950-51, and 1951-52 ice did form here to a thickness of 6 to 8 inches, and the entire lake froze over. Depth of water at the dam is about 400 feet. Above the mouth of Spokane River, where the water is about 250 feet deep, during the above-mentioned winters ice formed from 10 to 24 inches thick. The period of tie-up in water transportation extended from December to March.

During most years, the surface level of the Libby dam reservoir would vary between the highwater mark of 2459 feet above sea level and 2322 feet, a range of 137 feet. During a few years the drop would be much greater. This fluctuation constitutes a major operating problem. Experience on Lake Roosevelt behind Coulee Dam has emphasized that fact. Figure 37 is a photograph of the railroad dock and derrick at West Kettle Falls on Lake Roosevelt for unloading lumber from barge to rail. For the normal drawdown ranges of 20 to 30 feet on Lake Roosevelt, the installation is reasonably adequate. For the 60-foot drawdown shown in the photograph, it is completely inadequate and was, in fact, out of operation when the photograph was taken in April 1952.

For the most part, the feasibility of water transportation is related to the operating range of the log-handling equipment. Bigger equipment is required for a bigger drawdown. On the other hand, bigger equipment is more expensive. Thus, there is a point beyond which the additional expense is not justified. From observations of logging and lumber operations at Coulee Dam, several operators on the Olympic Peninsula, and the data in figure 38, best judgment is that the breaking point on the Libby dam reservoir is a 60-foot drawdown. Figure 38 was prepared from data given by the Corps of Engineers' Libby Project Monthly Duration Curves for Pool Elevation and Drawdown. It shows the percent of time in each month when the water level would be above the 40-, 60-, and 80-foot drawdown stages. The period from the middle of December to the middle of March is shown as nonoperable due to probable ice conditions on the reservoir. The period from the middle of March to about the last week in April is nonoperable due to the spring breakup of roads and the inability to truck logs to the

water. Likewise, it is considered that water transportation is nonoperable for periods when the water level is not within the operating range for at least 70 percent of the time.

Figure 37. Lumber-handling facilities on Roosevelt Lake with a 60-foot drawdown.

For a 40-foot drawdown the chart indicates an operable season from the first week in June to the middle of November, $5\frac{1}{4}$ months. However, it is shown that there is no time during the year when the reservoir would be held within a 40-foot drawdown 100 percent of the time. Water transportation cannot be considered practicable if a water level 100 percent within the operating range cannot be assured for an appreciable period.

The line for a 60-foot drawdown indicates an operable season from the last week in May to the middle of December, 6-3/4 months. During this period a reservoir level within a 60-foot drawdown range for 100 percent of the time is assured from the first of July to the first of October, 3 months.

For an 80-foot drawdown the chart indicates an operable season from the first week in May to the middle of December, $7\frac{1}{4}$ months. The reservoir level stays within the 80-foot drawdown for 100 percent of the time from the first of June to the first of December, 6 months.

In consideration of the increase in lumber-handling costs as between a 60-foot and an 80-foot lift into and out of the reservoir, the increased cost of equipment for making an 80-foot lift practicable, and the probability that these increased costs would be incurred with the advantage of only a two-week increase in length of operating season, it is concluded that the economical operating range for water transportation on the Libby dam reservoir is 60 feet.

RELATIONSHIP BETWEEN DRAWDOWN RANGE AND EXTENT OF OPERATING SEASON

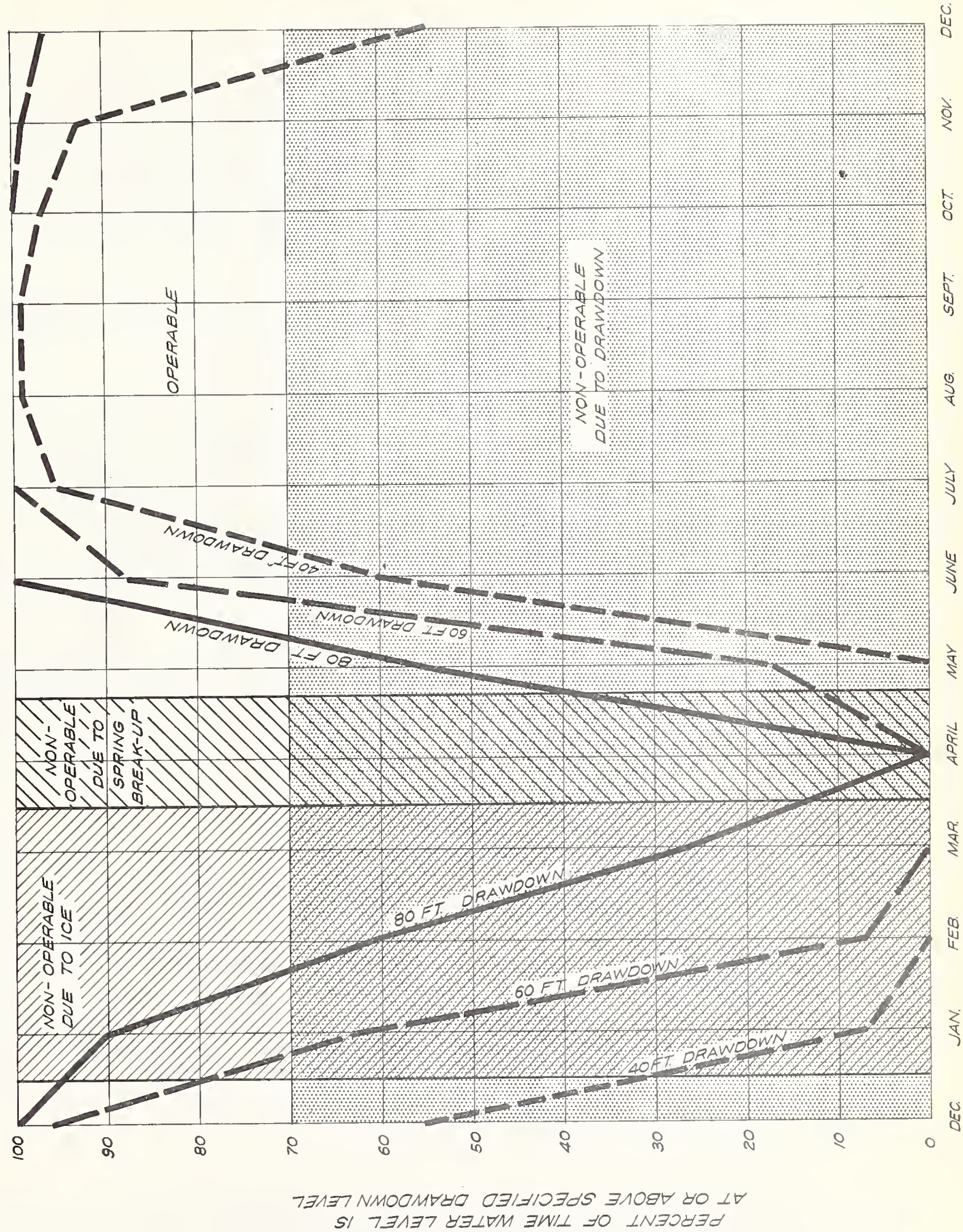


Figure 38

Special lumber-handling facilities would be required to put logs in the reservoir and take them out of the reservoir over a 60-foot range of water level.

To prevent, or at least sharply reduce, losses from "sinkers" and logs escaping under boom sticks in rough water (which can amount to five percent or more) and also to reduce handling costs, it is planned that all logs going into the water would be bundled with wire rope chokers. Full truck loads of logs, containing up to 7500 board feet, would be bundled on the truck either in the woods at the log landing or at the dump before being lifted into the water. Consequently, all lumber-handling equipment must have a normal operating capacity of 40 tons as a minimum.

At the permanent log dumps for lowering wood into the water, independent bridge cranes with inclined tracks into the water are recommended. The type of facility proposed is sketched in figure 39.

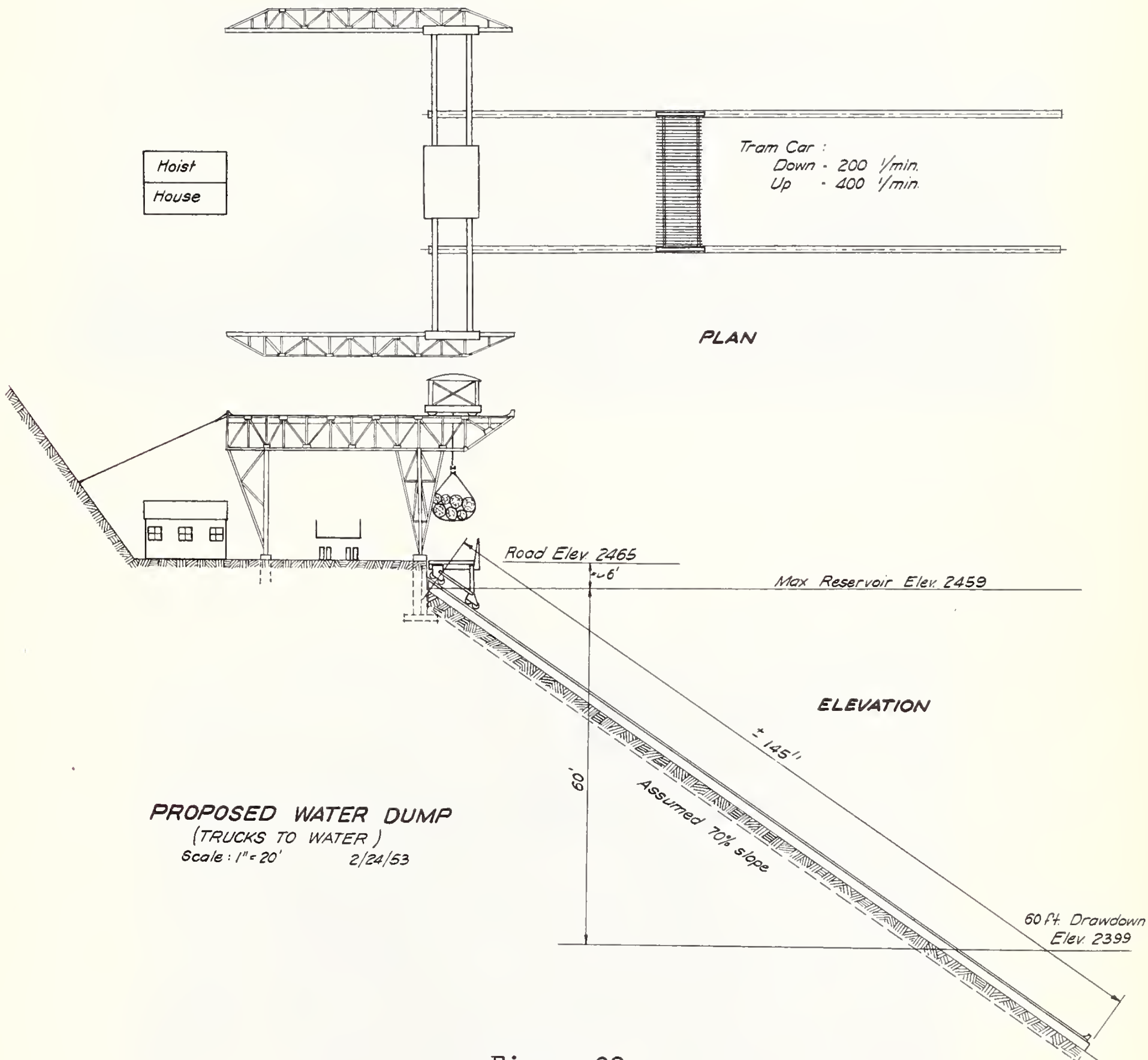
Figure 40 shows such a crane operating at the railroad reload pond of the Harbor Plywood Corporation near Amboy, Washington. As proposed for use in connection with the Libby reservoir, bundled loads lifted from the trucks would be placed on the tram of the inclined railway. The tram would then be lowered below water level to allow the bundle to float free and be pushed into a holding bay behind the anchored booms. The cost of this installation, exclusive of approach roads and anchored booms, for a minimum capacity of 40,000 board feet per hour is estimated at $190,000.

Less elaborate dumps would be required at other points along the reservoir where the flow of logs would be smaller and intermittent. These dumps could be used during high water periods permitting the use of A-frame stiff leg derrick type facilities. They would be temporary to the extent that the power unit might be moved from one dump to another. The cost of each facility would be about $50,000.

All of the dumps would require the construction of access roads and anchored booms which could rise and fall through a wide range of water level to store logs until they were assembled into rafts for towing.

The facility for taking logs out of the water would handle all logs to be transported by water.17/ Accordingly, a greater expense can be justified in planning an installation that will lift bundled loads directly from the water to waiting trucks without incurring the delays incident to the additional tram car operation of the dump facilities. Figure 15 on page 23, and figure 40 on page 113 illustrate the type of machinery which would be used.

17/In the case of the lower dam site, it is proposed that the facility for taking logs out of the water would be located about one mile upstream from the dam, in an area on the south side of the reservoir opposite Rainy Creek. This area is located near the east line of Section 31, T31N, R30W.



Hoist
House
Tram Car :
Down - 200 '/min.
Up - 400 '/min.
PLAN
Road Elev. 2465
6'
Max Reservoir Elev. 2459
ELEVATION
± 145'
60'
Assumed 70% slope
60 ft. Drawdown
Elev. 2399
PROPOSED WATER DUMP
(TRUCKS TO WATER)
Scale : 1" = 20'
2/24/53

Figure 39

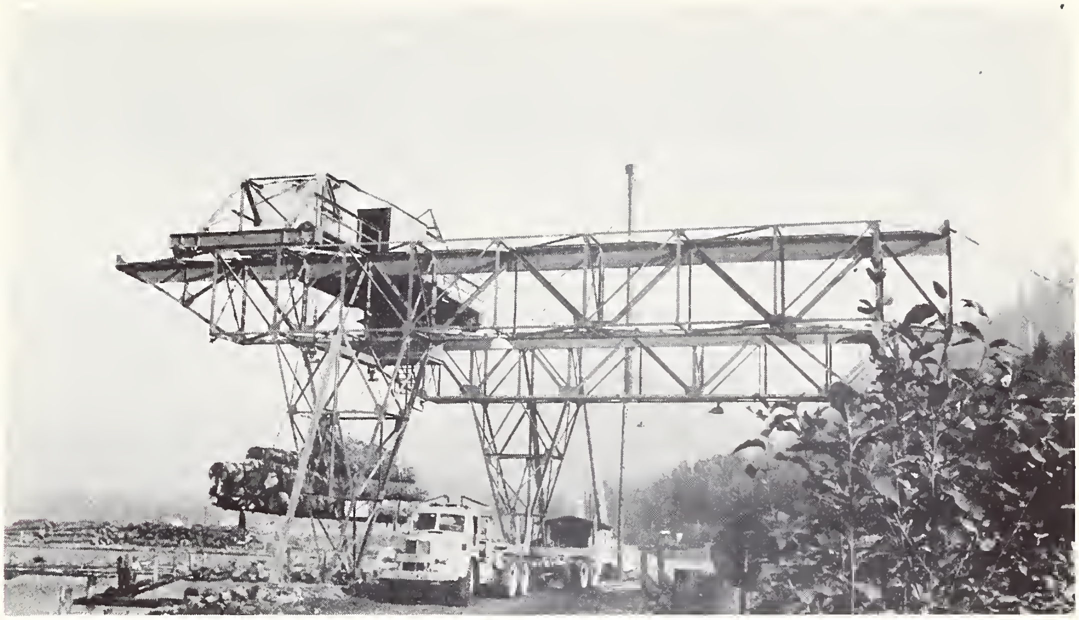


Figure 40. Log dump facilities at Amboy, Washington.

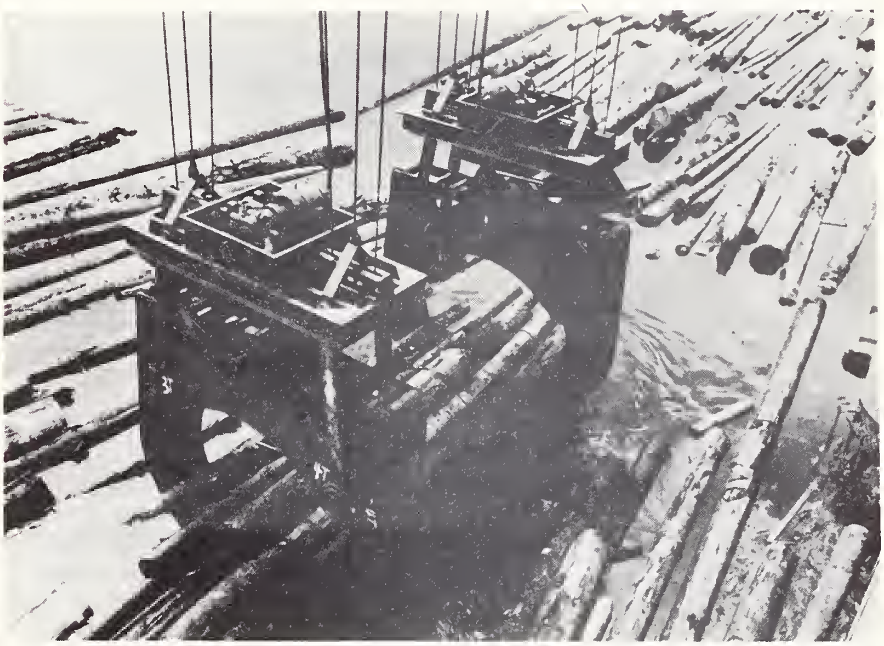


Figure 41. Grapples of a heavy derrick of the type recommended for the lift-out facilities.

Bundled loads would be floated into position under the crane, where they would be engaged by the hydraulically operated grapples, lifted and moved horizontally to the truck. The crane illustrated, which is in operation at the Crown-Zellerback Paper Mill at Camas, Washington, has a net capacity of 50 tons, extends 60 feet over water, has an opening of 70 feet between trusses, and lifts bundled loads a maximum of 80 feet. As applied to the Libby reservoir installation, it would be desirable to excavate into rock under the reach of the crane, to create a log bay.

Without such excavation, due to the slope of the ground it would be necessary to extend the reach of the crane beyond practical limits. The handling capacity of the load-out facility is recommended as 40,000 board feet an hour. The estimated cost of this installation, exclusive of approach road and anchored booms, is $250,000.

It would be necessary to transport the wood from the load-out facilities to Libby. Three possibilities present themselves: the timber could be flumed either directly from the load-out point or from a point below the dam to a community pond near Libby; it could be moved by aerial tramway from the load-out point to a community cold deck near Libby; or it could be trucked. Although detailed cost analyses have not been made of either flume or tramway operation, both have been ruled out for the following reasons:

1. The construction and maintenance cost of a parallel service road to the load-out facility would be incurred in either case.

2. Water for flume from the load-out facility would have to be supplied by pumping.

3. A flume from a point below the dam where its water could be supplied by gravity would entail an extra handling cost between the load-out facility and the intake of the flume.

4. Either the flume or tramway must terminate at a community facility and log purchasers must still face the rehandling and transportation costs to their own plants.

5. The construction cost of either alternate would approach if not exceed the cost of a log-haul road.

6. The analysis of the report on timber-production costs indicates that by trucking from the dam to Libby, wood-production costs would be maintained within present limits without the appreciable extra construction cost that would be incurred by building a flume or a tram.

It is recommended that the wood be trucked from the dam to Libby over Route S. This haul would cost about $1.80 a thousand board feet, which would be 26 percent of the total cost of transportation of that portion of the sawlog timber that would move by water. Truck hauling the cordwood from the dam to Libby would cost $1.08 a cord.

Equipment requirements will differ for Studies 1, 2, and 3 because operating plans would not be the same. Moreover, a greater volume of timber would be hauled by water in Study 1 than in Studies 2 and 3. Table 51 shows the volume of sawlogs and cordwood which would move on the reservoir in each case. Tables 52, 53, and 54 list the equipment required to conduct the water operations contemplated in Studies 1, 2, and 3. They also show the original cost and the calculated annual capital cost based on the estimated useful life of each item.18/

Table 51. Average annual timber volume which would be transported by water in Studies 1, 2, and 3

Logging unit group	Sawtimber		Cordwood	
	Study 1	Studies 2 and 3	Study 1	Studies 2 and 3
	Thousand board feet		Cords	
Libby	3,410	2,138	5,322	3,474
Warland	9,941	5,598	16,554	9,806
Stonehill	5,602	5,602	8,964	8,964
Rexford	8,989	4,589	11,080	5,480
Lower Fisher	2,640	1,296	3,040	1,495
Total	30,491	19,223	44,960	29,219

The cost estimates of the log-handling facilities discussed in this section on water transportation represent the best that can be presented short of estimates based on design drawings. Several firms, and particularly the Berger Engineering Company of Seattle, the designers and builders of the Amboy and Camas, Washington cranes illustrated herein, have been consulted in arriving at the performance requirements and cost estimates. The estimates are believed to be sufficiently accurate to result in a proper analysis of wood-transportation costs by water. They should not be used for appropriation requests, or similar purposes, until confirmed by design estimates.

18/In Studies 2 and 3 it has been assumed that part of the investment in water facilities could be borne by the wood-procurement operation. Each table indicates the proportion of the cost the Corps of Engineers would be expected to pay. In the wood-procurement calculations presented later, it has been further assumed that all of the water facilities costs not paid for by the Corps of Engineers would be charged against the sawtimber.

Table 52. Investment required in water facilities, Dam Site 204.9

Study 1

Item	Initial installed cost	Useful life	Residual value at end of term	Total annual cost of capital	Remarks
	Dollars	Years	Dollars	Dollars	
5 unloaders A frame	250,000	20	25,000	15,070	Includes installation and access roads
5 unloaders, crane and car	950,000	33-1/3	95,000	40,508	Includes installation and access roads
6 sets boom sticks	7,200	7	360	1,090	Includes making and chains
1 tow cable, 1000-foot	600	5	60	118	
1 tug boat, 38-foot	40,000	20	4,000	2,411	100 H.P. Diesel power
4 row boats	400	6	0	72	Miscellaneous use around booms
1 motor boat	2,000	12	200	181	For booming and sacking
In booms and anchors	30,000	10	1,500	3,295	$10 a linear foot located at load-in places
Out booms and anchors	30,000	15	1,500	2,340	Installation at log removal point
2 barges	8,000	12	400	753	For transportation of supplies and equipment
1 load-out crane	250,000	33-1/3	25,000	10,660	At load-out point. Includes installation.
Small tools	400	1	0	410	Axes, peavies, pike poles, etc.
700 cable wraps	7,000	4	1,400	1,521	700 wrappers with hooks at $10
Total	1/ 1,575,600			78,429	

1/ All facilities to be installed by Corps of Engineers.

Table 53. Investment required in water facilities, Dam Site 204.9

Study 2

Item	Initial installed cost	Useful life	Residual value at end of term	Total annual cost of capital	Remarks
	Dollars	Years	Dollars	Dollars	
6 unloaders A frame	300,000	20	30,000	18,084	Includes installing and access roads
2 unloaders, crane and car[1/]	380,000	33-1/3	38,000	16,204	Includes installing and access roads
4 sets boom sticks	4,800	7	240	727	Includes making and chains
1 tow cable, 1000-foot	600	5	60	118	
1 tug boat, 38-foot	40,000	20	4,000	2,411	100 H. P. Diesel power
4 row boats	400	6	0	72	Miscellaneous use around booms
1 motor boat	2,000	12	200	181	For booming and sacking
8 in booms and anchors[2/]	24,000	10	1,200	2,636	$10 a linear foot located at load-in places
1 out boom and anchor[1/]	30,000	15	1,500	2,340	Installation at log removal point
2 barges[2/]	8,000	12	400	753	Necessary to water logging at load-out point
1 load-out crane[1/]	250,000	33-1/3	25,000	10,660	Includes installation
Small tools	400	1	0	410	Axes, peavies, pike poles, etc.
500 cable wraps	5,000	4	1,000	1,082	Wrappers with hooks at $10
Total	1,045,200			55,678	

1/ Installed by Corps of Engineers. 2/ In part by Corps of Engineers.

Table 54. Investment required in water facilities, Dam Site 204.9

Study 3

Item	Initial installed cost	Useful life	Residual value at end of term	Total annual cost of capital	Remarks
	Dollars	Years	Dollars	Dollars	
7 unloaders A frame	350,000	20	35,000	21,098	Includes installing and access roads
1 unloader, crane and car 1/	190,000	33-1/3	19,000	8,102	Includes installing and access roads
4 sets boom sticks	4,800	7	240	727	Includes making and chains
1 tow cable, 1000-foot	600	5	60	118	
1 tug boat, 38-foot	40,000	20	4,000	2,411	100 H. P. Diesel power
4 row boats	400	6	0	72	Miscellaneous use around booms
1 motor boat	2,000	12	200	181	For booming and sacking
8 in booms and anchors 2/	24,000	10	1,200	2,636	Located at load-in places
1 out boom and anchor 1/	30,000	15	1,500	2,340	Installation at log removal point
2 barges 2/	8,000	12	400	753	Necessary to water logging
1 load-out crane 1/	250,000	33-1/3	25,000	10,660	At load-out point. Includes installation.
Small tools	400	1	0	410	Axes, peavies, pike poles, etc.
500 cable wraps	5,000	4	1,000	1,082	Wrappers with hooks at $10
Total	905,200			50,590	

1/ To be installed by Corps of Engineers. 2/ In part by Corps of Engineers.

Table 55 itemizes the maintenance cost of water facilities. The maintenance cost was first calculated solely on the basis of a sawtimber operation assuming the total annual maintenance cost of each facility would bear the following relationship to the original investment in that facility:

	Percent
Unloaders A frame	2
Hoist crane and car, unloaders	1
Set boom sticks	10
Tow cable	1
Tug boat	5
Row boat	50
Motor boat	5
In booms and anchors	1
Out booms and anchors	1
Barges, 22 feet x 50 feet	3
Load-out crane and car	1
Small tools	-

The total annual costs thus derived were then divided by the number of board feet to be transported by water in each case to obtain the figures entered in table 55. It was further assumed that transporting cordwood by water in addition to the sawtimber would involve an additional maintenance cost per cord about 40 percent as large as the per-thousand rate in table 55.

Table 56 presents the annual cost of operating the water facilities exclusive of depreciation and maintenance. Due to the greater difficulties and labor requirements in handling smaller materials than sawlogs with this equipment, it has been estimated that the operating cost per unit of wood would be about 50 percent greater for the cordwood ($2\frac{1}{2}$ cords a thousand board feet).

An important factor to the successful operation of a water transportation system is its coordination with the operation of the reservoir. Logging operators should be advised, as far in advance as possible, when the water level would be raised or lowered and how fast. The forecast would affect logging plans for those logging units served only by "temporary" dump facilities. It would also affect both the storage of logs behind booms and the storage of rafts since a sudden drawdown might leave them stranded on the reservoir banks. Likewise, a sudden rise in water level might cause booms or rafts to break free from anchorages.

If the advantages of water transportation are to be employed in developing a transportation system that results in least impact on present wood-procurement costs, the dam building agency should be responsible for construction of the planned dumps and load-out facilities that make the method feasible. Each of transportation Studies 1, 2, and 3 contemplates project construction of the load-out facility and certain of the planned dumps, in addition to the road and trail, building, communication and landing field restorations that are required. It is considered that the operation and maintenance of the project-financed water facilities must be performed by the government agency responsible for the dam and reservoir operation. Similar to Forest Service practice in providing for the maintenance of

Table 55. Maintenance of water facilities, Dam Site 204.9

	Sawlogs: Per thousand board feet	Sawlogs: Total annual	Cordwood: Per cord	Cordwood: Total annual	All timber: Total annual
	Dollars				
Study 1 (30,491 thousand board feet and 44,960 cords)					
10 unloaders	.476	14,500	.190	8,542	23,042
1 load-out works	.082	2,500	.033	1,484	3,984
Boats, barges, booms, etc.	.128	3,900	.051	2,293	6,193
Total	.686	20,900	.274	12,319	33,219
Study 2 (19,223 thousand board feet and 29,219 cords)					
8 unloaders	.510	9,800	.204	5,961	15,761
1 load-out works	.130	2,500	.052	1,519	4,019
Boats, barges, booms, etc.	.187	3,600	.075	2,191	5,791
Total	.827	15,900	.331	9,671	25,571
Study 3 (19,223 thousand board feet and 29,219 cords)					
8 unloaders	.463	8,900	.185	5,406	14,306
1 load-out works	.130	2,500	.052	1,519	4,019
Boats, barges, booms, etc.	.187	3,600	.075	2,191	5,791
Total	.780	15,000	.312	9,116	24,116

Table 56. Cost of operating water facilities, including truck haul from dam to mill, Dam Site 204.9[1/]

Studies 1, 2, and 3

	Sawlogs per thousand board feet	Cordwood per cord
	Dollars	
Into water	.39	.23
Towing	.81	.49
Loadout	.57	.34
Haul to mill	1.80	1.08
Total	3.57	2.14

1/Per thousand board feet and cord actually moved by water. Maintenance and capital charges not included.

special service log haul roads, the cost of operation and maintenance should be provided for by each user's payment into a cooperative fund at an adequate rate per unit of wood products handled through the facility.

Rail costs--postdam transportation system

The transportation studies for Dam Site 204.9 have been handicapped by the fact the final relocation route of the Great Northern Railway has not been settled. On advice from the Corps of Engineers at the time this study was begun it has been assumed that the route would be as shown on the maps of Studies 1, 2, and 3; that is, from Libby south along US Highway 2 to the Fisher River, down the Fisher River to Wolf Creek, up Wolf Creek to the Wolf Creek-Fortine Creek summit and down Fortine Creek to the existing railroad line at Stryker. At this writing, the route from Libby to the mouth of Wolf Creek is particularly in question. If the route as assumed by this report is changed, rail freight costs from Eureka and the landings in the Wolf Creek and Fisher River drainages to Libby would be affected. Likely, some change would occur in the method of transportation determined as the cheapest for individual logging units in these areas. In these instances, the production from these units would be routed differently than indicated by the road cost analyses of Studies 1, 2, and 3. However, the effect of these possible changes would be minor on the Zone of Influence as a whole and would not alter the conclusions of this report.

The length of haul and the freight rates over the proposed location for both sawlogs and cordwood, as estimated for use in this report, are given in table 57. These figures are compared to the length of haul, the established 1951 sawlog freight rates, and the estimated cordwood rates over the existing location.

Table 57. Existing and assumed future railroad freight rates from various points to Libby

To Libby from	Existing location			Proposed location		
	Miles	Sawlogs	Cordwood	Miles	Sawlogs	Cordwood
		Per thousand bd.ft.	Per cord		Per thousand bd.ft.	Per cord
Rexford	55	2.95	2.42			
Stonehill	44	2.55	2.27			
Warland	24	2.15	2.00			
Eureka				126	4.58	3.45
Landing 1 (Upper Wolf Creek)				76	3.51	2.72
Landing 2 (Wolf Prairie)				64	3.29	2.57
Landing 3 (Tamarack Creek)				57	3.13	2.42
Landing 4 (Mouth Wolf Creek)				48	2.98	2.27
Landing 5 (Fisher River at Highway 2)				31	2.54	2.13

The cordwood rates used above are taken from those used in Station Paper 34, "Resource Factors Affecting the Feasibility of Pulp Mills in Eastern Montana," a 1952 publication of the Northern Rocky Mountain Forest and Range Experiment Station. The sawlog freight rates over the proposed location are based on the established 1951 rates over the existing location with an approximate 10 percent increase to allow for higher operating costs.

Study 1 transportation system

Figure 42 shows the transportation system proposed by Study 1. It provides the following facilities:

Roads

Route W, Sections A to I, inclusive, provides a back-country fire protection route (partly usable for log haul) along the west side of the reservoir from a connection with existing State Highway 37 below the dam to a connection above flowline with the existing road system on the west bank opposite Rexford.

Route S, Sections A and B, on the south side of the reservoir provides a connection with existing forest development road 759 below the dam to the proposed water load-out facility above the dam, opposite Rainy Creek.

Route P, Sections A to C, inclusive, provides a back-country protection route along McMillan Creek Divide to Tony Peak Lookout, replacing the protection access now provided by forest development road 759.

Route E, Sections A to G, inclusive, planned as the relocation of State Highway 37. Section H, a log haul road connection to Ten Mile Creek.

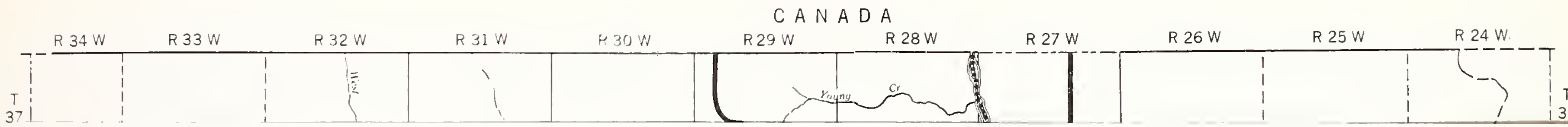
Route E-N, Sections A to C, inclusive, provides a back-country fire protection route (log haul, in part) connecting the highway relocation with the relocated ranger station at Eureka. Section D, a log haul road connection to McGuire Creek.

Trails

Route T-1, 13.3 miles long, from the water load-out facility along the south face of the reservoir to Peoples Creek in the Fisher River drainage.

Route T-2, 16.7 miles long, from a connection with road Route W at the mouth of Rainy Creek along the north face of the reservoir to Little Jackson Creek.

Route T-3, 12.9 miles long, from a connection with road Route W at Bristow Creek along the west face of the reservoir to connect with Route W at the mouth of the Middle Fork Parsnip Creek.


CANADA
R 34 W
R 33 W
R 32 W
R 31 W
R 30 W
R 29 W
R 28 W
R 27 W
R 26 W
R 25 W
R 24 W.
T 37
T 37
West
Young
Cr


CANADA
PROPOSED LIBBY DAM RIVER MILE 204.9
ROUTE E-N
ROUTE-W
ROUTE-E
ROUTE S
ROUTE P
ZONE OF INFLUENCY BOUNDARY
SUB-ZONE BOUNDARY
LIBBY
Eureka
REXFORD
TROY
CABINET NATIONAL FOREST
FLATHEAD NATIONAL FOREST
U.S. FOREST SERVICE
LIBBY DAM PLANNING PROJECT
STUDY I
TRANSPORTATION SYSTEM RELOCATIONS
-LEGEND-
ROAD CONST. STANDARD
STATE HIGHWAY 37 (PROJECT RESTORATION)
BB28
BB24
FOREST DEVELOPMENT ROADS (PROJECT RESTORATION)
BB28
BB24
DD16
D16
EE12
E12
TRAILS (PROJECT RESTORATION)
WATER TRANSPORTATION FACILITIES
LOADING OUT FACILITY (PROJECT RESTORATION)
PERMANENT DUMP FACILITIES (PROJECT RESTORATION)
TEMPORARY DUMP FACILITIES (NON PROJECT)
GREAT NORTHERN RAILROAD
ASSUMED RELOCATION ROUTE (PROJECT RESTORATION)
TIMBER RELOAD LANDINGS (NEW PROJECT)
LANDING FIELD (PROJECT RESTORATION)
ADMINISTRATIVE IMPROVEMENTS
PROPOSED RANGER STATION (PROJECT RESTORATION)
PROPOSED WORK CENTER (PROJECT RESTORATION)
REVISED RANGER DISTRICT BOUNDARIES

Figure 42

Route T-4, 10.1 miles long, from a connection with Section H of Route E at the mouth of Ten Mile Creek along the east face of the reservoir to connect with Section D of Route E-N at the mouth of McGuire Creek.

Landing field

Relocation of the existing field in Sections 27 and 28, T31N, R31W, including required relocation of affected portion of existing Pipe Creek forest development road 68.

Water facilities

Project-financed "permanent" dumps as follows:

Dump D-A at Barron Creek
Dump D-B at Big Creek
Dump D-C at Warland Creek
Dump D-D at Sullivan Creek
Dump D-E at Rexford

"Temporary" dumps to be financed by national forest timber sales as follows:

Dump D-1 at Johnson Draw
Dump D-2 at Big Bend
Dump D-3 at Sutton Creek
Dump D-4 at Buck Creek
Dump D-5 at mouth of Fisher River (east side)

Project-financed load-out facility on south side of reservoir, approximately one mile upstream from dam, in Section 31, T31N, R30W.

Rail facilities

Railroad reload landings along the proposed location of the Great Northern Railway to be financed by national forest and/or private timber operations, as follows:

Landing 1 at Upper Wolf Creek
Landing 2 at Wolf Prairie
Landing 3 at Tamarack Creek
Landing 5 at Fisher River on US Highway 2

A realignment of national forest ranger district boundaries would be necessary if the Study 1 transportation plan were adopted. Three districts, with ranger stations at Bristow Creek, Wolf Creek, and Eureka, and work centers at Big Creek and Warland Creek would be required to replace the effectiveness to a reasonable degree of the two existing combined ranger station-work center establishments at Warland and Rexford. The realigned boundaries are shown in figure 42.

In Study 1 no attempt has been made to justify particular road construction standards from the standpoint of more economical total road and transportation cost. Construction standards of minimum adequacy for the required service of the various sections have been determined and the transportation costs computed for these minimum standards only. The cost analysis of the Study 1 road system is given in table 58.

The cost analysis gives the estimated construction cost of each route, converts this to the annual cost of capital which, added to the annual maintenance cost, results in the total annual road cost. The annual vehicle operating costs are computed for each of the five kinds of traffic, totaled, and then added to the annual road cost to give finally the total annual road and transportation cost for that route.

The annual timber-hauling costs are derived from the schedule of table 59, which for Study 1 shows the mode of transport for each logging unit based on use of the cheapest method without regard to yearlong log procurement.

The details of route and construction standard selection, as determined by the services required of the route, are explained in the following paragraphs:

Route W. The primary purpose of this route is to provide a seasonal-use minimum cost through road from Libby to a connection with the Yaak Valley-west side forest development road 92 in the vicinity of Sullivan Creek for fire protection and administration of the forest area along the west side of the reservoir. Since minimum construction cost is a primary objective, the location is generally in high country away from the expensive rock construction of the reservoir face. However, because of difficult topography in the high country north of Parsnip Creek, the route is along the reservoir face at Parsnip Creek to serve also as a log haul road providing access to water transportation dumps for the timber areas from Parsnip Creek north to the international boundary. Other sections of the road between Libby and Parsnip Creek are used for log haul or public travel where they are on suitable location.

Under Study 1 road system, Route W provides a summer season outlet to Libby, 73 miles distant, for the 15 or so families now residing in the vicinity of Tooley Lake (between Young Creek and Dodge Creek at the northwest end of the reservoir). Under present conditions these families trade at the nearby towns of Rexford and Eureka, on the east side of the Kootenai River. Since Route W would be purely a seasonal route and would not be maintained yearround, the isolation of these people in the winter is an important deficiency of the transportation plan.

Section A is 2.2 miles long from a connection with existing Highway 37, about 0.7 mile north of the Libby bridge to the dam axis. The location is on a 2-percent grade for 1.3 miles and 4 percent for the remaining 0.9 mile to the dam site. To accommodate the estimated annual traffic of 81,500 recreational

Table 58. Summary of road system cost analyses

Study 1

	Unit	Route						Entire system
		W	W-N	S	P	E	E-N	
Length	Miles	65.6	-	2.9	9.25	76.1	52.3	206.15
Total construction cost	Dollars	4,348,142	-	408,697	160,469	6,962,310	2,730,872	14,610,490
Annual road cost								
Construction	Dollars	184,795	-	17,370	6,820	295,898	116,062	620,945
Maintenance	Dollars	23,700	-	1,820	833	61,543	6,596	94,492
Total	Dollars	208,495	-	19,190	7,653	357,441	122,658	715,437
Annual transportation cost								
Wood products	Dollars	12,191	-	19,709	-	39,985	6,264	78,149
Mineral products	Dollars	91,444	-	-	-	-	-	91,444
Recreational travel	Dollars	66,621	-	4,524	1,111	394,817	10,906	477,979
Commercial travel	Dollars	64,356	-	6,160	-	343,111	11,403	425,030
National forest administration	Dollars	19,504	-	536	866	16,653	7,168	44,727
Total	Dollars	254,116	-	30,929	1,977	794,566	35,741	1,117,329
Total annual road and transportation cost	Dollars	462,611	-	50,119	9,630	1,152,007	158,399	1,832,766

Table 59. Annual cut by logging units and mode of tranaporting wood[1/]

Study 1

Logging unit	Summer cutting: Sawlogs	Summer cutting: Pulpwood	Summer cutting: Mode of transport	Winter cutting: Sawlogs	Winter cutting: Pulpwood	Winter cutting: Mode of transport
	Thousand bd.ft.	Cords		Thousand bd.ft.	Cords	
			Libby group			
80	212	368	Truck to Libby			
81	676	1,059	Truck to Libby			
82	353	534	Truck to Dump 2			
84	561	917	Truck to Dump 2			
113	1,735	2,735	Truck to Dump 5			
179	761	1,136	Truck to Dump 1			
			Warland group			
85	171	322	Truck to Dump A			
86	843	1,461	Truck to Dump A			
87	913	1,567	Truck to Dump A			
88	1,355	2,227	Truck to Dump A			
89	438	759	Truck to Dump A			
108	1,254	1,974	Truck to Dump C			
109	1,435	2,186	Truck to Dump C			
110	606	968	Truck to Dump C			
111	1,859	3,108	Truck to Dump C			
112	1,067	1,982	Truck to Dump C			
			Stonehill group			
90	566	889	Truck to Dump B			
91	621	1,133	Truck to Dump B			
94	700	1,250	Truck to Dump B			
97	716	1,007	Truck to Dump B			
98	453	808	Truck to Dump B			
106	1,641	2,160	Truck to Dump 3			
107	905	1,717	Truck to Dump 3			
			Rexford group			
99	973	895	Truck to Dump D			
100	1,143	1,547	Truck to Dump D			
101	719	1,031	Truck to Dump D			
102	1,523	2,340	Truck to Dump D			
103	1,599	2,209	Truck to Dump E			
104	1,346	1,616	Truck to Dump E			
105	1,595	1,442	Truck to Dump E			
			Lower Fisher group			
151	519	642	Truck to Dump 5			
152	519	588	Truck to Dump 5			
153	345	436	Truck to Dump 4			
154	625	513	Truck to Dump 4			
155	632	861	Truck to Dump 4			
			Mid-Fisher group			
149	595	754	Truck via McMillan Pass	113	143	Truck via McMillan Pass
156	401	402	Truck via McMillan Pass	236	237	Truck via McMillan Pass
157	217	213	Truck via McMillan Pass	67	65	Truck via McMillan Pass
158	226	209	Truck via McMillan Pass	149	137	Truck via McMillan Pass
160	671	758	Truck via McMillan Pass	204	231	Truck via McMillan Pass
161	247	257	Truck via McMillan Pass	70	73	Truck via McMillan Pass
162	282	294	Truck-rail via Landing 5	154	199	Truck-rail via Landing 5
163	489	465	Truck-rail via Landing 5	122	116	Truck-rail via Landing 5
			Upper Fisher group			
174	850	1,284	Truck-rail via Landing 5	102	154	Truck-rail via Landing 5
164	30	24	Truck-rail via Landing 5	114	89	Truck-rail via Landing 5
165	316	259	Truck-rail via Landing 5	376	307	Truck-rail via Landing 5
166	272	204	Truck-rail via Landing 5	408	305	Truck-rail via Landing 5
167	475	869	Truck-rail via Landing 5	119	217	Truck-rail via Landing 5
168	1,569	2,639	Truck-rail via Landing 5	11	18	Truck-rail via Landing 5
169	1,951	3,268	Truck-rail via Landing 5	-	-	-
170	471	549	Truck-rail via Landing 5	23	27	Truck-rail via Landing 5
171	1,588	2,403	Truck-rail via Landing 5	-	-	-
172	1,031	1,134	Truck-rail via Landing 5	437	482	Truck-rail via Landing 5
173	431	307	Truck-rail via Landing 5	204	143	Truck-rail via Landing 5
			Wolf Creek group			
139	2,270	3,515	Truck-rail via Landing 1	-	-	-
140	1,039	1,517	Truck-rail via Landing 2	460	671	Truck-rail via Landing 2
141	436	531	Truck-rail via Landing 2	76	92	Truck-rail via Landing 2
142	1,479	1,320	Truck-rail via Landing 2	531	532	Truck-rail via Landing 2
143	327	493	Truck-rail via Landing 2	306	461	Truck-rail via Landing 2
144	1,530	1,807	Truck-rail via Landing 3	429	506	Truck-rail via Landing 3
150	756	692	Truck via McMillan Pass	230	210	Truck via McMillan Pass
Total for zone of influence (except logging units 92, 93, 95, 96)	51,328	72,522		4,941	5,415	

1/ All summer and winter cutting areas to be cut in summer and transported by water except where truck or truck-rail transportation is cheaper.

cars visiting the dam, 67,000 commercial vehicles, and the Zonolite ore haul of 152,000 tons to Libby, a BB-28 construction standard is proposed.

Section B is 4.2 miles long from the dam axis on a 0 percent grade to a connection with the existing Rainy Creek road at elevation 2500 and up the existing road on a 6-percent grade to the base of Zonolite Hill. The construction cost estimate includes improvement and asphalt mat paving of the 1.0 mile of existing road up Rainy Creek. Recreational traffic is expected to be comparatively heavy over this section (55,000 cars a year) as is commercial traffic serving the Zonolite mine and logging areas to the north (30,000 vehicles a year). A BB-28 construction standard is proposed to accommodate the recreational and commercial traffic plus the ore haul trucks which would come onto Section B at the base of the Zonolite Hill, and the logging trucks from units 80 and 81. This log haul traffic does not travel over Section A. The log trucks would be routed over a roadway on top of the dam to a connection with Route S for direct transportation to the Libby mill.

Section C, 4.2 miles long, extends from the base of Zonolite Hill, up the west slope of Rainy Creek on a 5-percent grade, to the Rainy Creek-Jackson Creek summit at elevation 3850. Wood production from logging unit 81 would be trucked over this section. Since Route W would not be a through public travel road, and would serve local populations only beyond Section B, the recreational traffic estimate drops to 4500 cars a year, and the commercial traffic to 2500 vehicles a year. A DD-16 construction standard is proposed to serve the combined log haul and administrative access traffic to the ranger station at Bristow Creek.

Section D, is 14.6 miles long from the Rainy Creek-Jackson Creek summit to the proposed ranger station at Bristow Creek. From the summit the location descends on a 1.7-percent grade down Jackson Creek and the North Fork of Jackson Creek to control points between elevations 3140 and 3000 above cliffs and deep draws in Sections 33 and 28, T32N, R29W. The location continues to descend, crossing Barron Creek at elevation 2800, climbs on a 2.3-percent grade to a favorable back-country pass between Barron and Bristow Creeks at elevation 3100, and finally descends on a 1.7-percent grade to the crossing of Bristow Creek. Section D has only incidental use for timber haul. Access to Dump A which serves logging units 85, 86, 87, 88, and 89 must be provided by branch roads financed by the timber operation. For its principal service as an administrative and protective access to the ranger station and district, a D-16 construction standard is proposed. The D-16 standard is basically the same as the DD-16 standard for log haul, which has been described in table 46, with these exceptions (1) the surfacing need not be as heavy and the width of the subgrade can be reduced accordingly, and (2) the surfaced turnout width

can be reduced from 28 feet to 24 feet. Sections A, B, C, and D are considered as yearlong routes and the maintenance cost estimates include the cost of snow removal. The sections north of Bristow Creek are for seasonal use and the estimates are for normal maintenance only.

Section E, 4.7 miles long, climbs from Bristow Creek on a 5-percent grade to elevation 4320 in a saddle at the head of Ural Creek west of Ziegler Mountain. This section would carry part of the wood production from logging units 88 and 89 to their outlet at Dump A. The estimate of recreational traffic drops to 2500 cars a year and that of commercial traffic drops to 1000 vehicles a year. An EE-12 construction standard is proposed to serve the log haul traffic and the protective and administrative travel out of the proposed Bristow Creek Ranger Station.

Section F, 9.5 miles long, extends from the head of Ural Creek to the upper end of Parsnip Creek. In this location, which avoids the particularly heavy construction along the reservoir face between Ziegler Mountain and Parsnip Creek, the road would serve protection needs only and is proposed for an E-12 construction standard. The location climbs as high as elevation 4650 between the heads of Ural and Geibler Creeks and stays above elevation 4200 until it turns into the Parsnip Creek drainage, where it drops on a 5-percent grade to the end of the section. It is estimated that no more than 500 commercial cars and trucks a year, primarily in connection with logging operations between Bristow and Parsnip Creeks, would use this section.

Section G is 10.7 miles long from the upper end of Parsnip Creek to Big Creek where the proposed work center for the west-side ranger district is located. The road location remains between elevations 2500 and 2600. This section serves as an access to Dump B for the timber production from logging units 90, 91, and 94. It is proposed for an EE-12 construction standard.

Section H is 6.4 miles long extending from Big Creek to Gold Creek and serving as an access to Dump B for the timber production from logging units 97 and 98. Since the Big Creek forest development road 336 provides an outlet for recreational traffic back to Libby via the Pipe Creek road, the estimate of recreational traffic in this section is only 1500 cars a year. Accordingly, an EE-12 construction standard is considered adequate.

Section I, 3.1 miles long, extends from Gold Creek to Boulder Creek through some of the most difficult construction to be found along the reservoir face. Accordingly, the dump locations have been planned to avoid the necessity for log haul along this section. Recreational use is estimated at 750 cars a year and commercial cars and trucks serving the logging operations north of Boulder Creek at 1250 a year. A minimum E-12 protection road standard is therefore considered adequate. The location varies between elevations 2550 and 2700 in using natural advantages to the greatest reasonable extent in reducing estimated construction costs.

Section J is 6.0 miles long extending from Boulder Creek to a junction with Yaak River-west side forest development road 92 at approximate elevation 2600 in Section 16, T36N, R28W. It serves as an access to Dump D for the timber production from logging unit 99, as well as an access to logging operations in units 100, 101, and 102 to the north, and is proposed for an EE-12 log haul road standard. From Boulder Creek the location climbs to approximate elevation 2850 in Section 31, T36N, R28W, to avoid construction through a particularly difficult rock point. From that point it descends on a sustained grade to its connection with the Yaak River-west side road.

Route S. The primary purpose of this route is to provide for the truck haul of timber from the water load-out facility directly to the Libby manufacturing plants. Secondarily, it would provide for public access to the recreational possibilities of the bench area immediately upstream from the load-out facility. This area also would be ideally suited to the installation of public dock and commercial boat facilities. It can be developed without interfering with timber handling or dam operations.

Section A extends 1.9 miles from a connection with the existing Libby-Jennings forest development road 759 in Section 2, T30N, R31W, on a 4-percent grade to the top of the dam. The existing road, which is privately owned and maintained, terminates at the J. Neils Lumber Company plant and public access through the plant is prohibited. In developing Route S for the public uses described above, a public road connection between Libby and the beginning of Section A along the route of an existing county road would be required. However, this connection cannot be considered within the scope of the Libby project transportation restorations and no cost estimate for the connection is included in this report. The BB-28 construction standard proposed for this section to allow rapid movement of "off-highway" log haul trucks would also be adequate for the estimated volumes of recreational and commercial traffic.

Section B is approximately 1.0 mile long from the dam to the load-out facility. A BB-28 construction standard is likewise proposed for this section. Additional length of road upstream from the load-out facility would be required to develop the public uses of this area. However, this additional length is not within the scope of transportation restorations and no estimate of its cost is included.

Route P. Access to Tony Peak Lookout and other areas along the north and east faces of McMillan Creek divide between the Libby Creek and Fisher River drainages is presently provided by the branch roads which connect with the Libby-Jennings and west side Fisher River forest development roads (759 and 763). Because the overburden on the rock slopes of the canyon walls above these main haul roads is considered particularly vulnerable to extensive slides when subjected to reservoir saturation and

drawdown, it is not desirable to relocate these roads along the flowline. The timber production from logging units adjacent to these roads should be moved by other routes. However, the area must still be protected from fire by road access and that is the purpose of Route P, proposed for the minimum E-12 construction standard.

Tony Peak Lookout would be connected to proposed Route E at the head of McMillan Creek by Sections B and C, a length of 6.75 miles. Section A, 2.5 miles long, would connect Sections B and C with existing forest development road 533 so that a continuous road access would be provided along the east-west ridge above the reservoir.

Route E, except for Section H, is the State Highway 37 restoration route of Studies 1 and 2. It extends from a junction with US Highway 2, approximately 4 miles south of Libby, 71.6 miles to US Highway 93 near Trego, approximately 14.9 miles southeast of Eureka. It is proposed for a BB-24 construction standard over its entire length. It would provide important services to timber transportation and national forest protection and administration, but so far as the Zone of Influence is concerned, only to the head of Five Mile Creek where the route leaves the Zone. As a highway restoration it has the advantages of avoiding locations of high construction cost, avoiding the necessity for major crossings of the reservoir either in the Kootenai or Fisher River drainages, and providing for reasonably direct travel between Libby and Eureka. Its disadvantages are that it must climb over two 4100-foot summits with attendant high snow removal costs, that its connection between Libby and Eureka is only reasonably direct. Both factors add to the operating costs of through highway users between Libby and Eureka. This route adds nothing to transportation service in the reservoir area north of Five Mile Creek, and offers only limited opportunity for public enjoyment of the scenic attractions of the reservoir. Its further disadvantages, in comparison with the highway restoration route of Study 3, are discussed later in this section of the appendix.

Sections A and B, 9.9 and 9.6 miles long, respectively, extend from the junction with US Highway 2, south of Libby, up the north slope of McMillan Creek on a 5-percent grade to its summit at elevation 4100, and down the Doe Creek and Fawn Creek drainages on a 3½-percent grade to the head of the reservoir in Fisher River at the mouth of Wolf Creek. The timber production from logging units 149, 150, 156, 157, 158, 160, and 161 would be trucked over these sections to Libby at modified unit rate costs which allow for the favorable grade on Section A, and the adverse grade on Section B. In accordance with the through car traffic estimates discussed on pages 104 and 105, recreational traffic is estimated at 60,000 cars a year and commercial traffic at 35,000 cars a year because of additional local use over these sections close to Libby. The headquarters station for the proposed Wolf Creek Ranger District, composed of parts of the predam Warland and Raven Districts, would be located at the mouth of Wolf Creek. Sections A and B provide access to the station

from Libby. The annual maintenance costs for both sections is estimated at the rate of $300 a mile for normal maintenance and $650 a mile for snow removal and sanding.

Section C, 12.5 miles long, extends from the mouth of Wolf Creek down the east bank of the Fisher River to Dunn Creek. It is located at approximate elevation 2550 for its entire length. The timber production from logging units 151, 152, and 113 would be trucked over parts of the section to water at Dump 5. Since part of the recreational and commercial traffic which uses Sections A and B would be diverted to the Wolf Creek and upper Fisher River areas, the recreational traffic estimate for Section C drops to 56,500 cars a year, and the commercial traffic to 33,500 vehicles a year.

Section D is 7.6 miles long, extending from Dunn Creek to Cripple Horse Creek. The location is along the reservoir face generally at elevation 2600 to 2650 until it approaches Cripple Horse Creek, where it drops to about elevation 2550. Immediately north of Dunn Creek the location passes along a deeply serrated rock cliff for approximately one mile, making it the most difficult construction along the entire reservoir. For this reason, an alternate location was considered which extends up Dunn Creek, switches back and climbs on a 5-percent grade to a pass on the Dunn Creek-Canyon Creek divide at elevation 3560, drops into Canyon Creek on a 3-percent grade, climbs out on a 2.5-percent grade to a pass on the Canyon Creek-Cripple Horse Creek divide at elevation 3240, and finally drops on a 3.8-percent grade to a common point at elevation 2550 in Cripple Horse Creek. The total length of this alternate location is 12.1 miles. The estimated construction cost of the alternate via the reservoir face is $1,243,228, or an average of $163,583 a mile, and results in an annual road cost of $58,537. The estimated construction cost of the alternate "high-line" location is $1,067,757, or an average of $88,244 a mile, resulting in the cheaper annual road cost of $58,875. However, transportation costs for the timber haul from logging unit 112 to Dump C, and for the estimated annual traffic of 50,000 recreational cars, 30,000 commercial vehicles, and 1550 administration and protection vehicles, are $78,050 for the face route and $123,519 for the "high-line" route. The difference in transportation costs is due almost entirely to the greater length of the "high-line" alternate since no increase in operating costs for recreational, commercial, or administrative traffic, because of increased gradients, is recognized for the purpose of this report. As a result, the total annual road and transportation cost for the alternate via the reservoir face is $136,587 compared to $180,394 for the "high-line" alternate. Thus, with a $43,807 favorable difference in annual road and transportation costs, the reservoir face alternate location is recommended despite its higher construction cost.

Section E, 6.0 miles long, extends from Cripple Horse Creek to Five Mile Creek. This section would serve timber production from logging units 108, 109, 110, 111, and 112 to water at Dump C. Since it is located along the reservoir face with its scenic attraction, it is estimated that recreational and commercial traffic would be the same as over Section D.

Section F is 7.8 miles long, extending up Five Mile Creek on a 5-percent grade to its summit at elevation 4100. The section is away from the reservoir and the recreational and commercial traffic is estimated to drop to the annual through volumes shown in tables 49 and 50, 47,500 recreational and 27,500 commercial vehicles. Timber production from the Five Mile Creek logging unit 109 is trucked over this section to water at Dump C.

Section G, 18.2 miles long, extends from the Five Mile Creek summit to US Highway 93 near Trego. The 4.9 mile portion of this section from the summit down Lake Creek to Fortine Creek is on the general location of the existing low-standard forest development road 48. The remaining length of 13.3 miles from Fortine Creek to US Highway 93 is over existing forest development road 36, presently maintained by Lincoln County. This section is now built to an 18-foot surfaced width with ditches, is on good grade and alignment, and will require relatively light reconstruction and paving to improve it to the proposed BB-24 construction standard.

Section H, not a part of the highway relocation, is 4.5 miles long, extending from a connection with the proposed highway at Five Mile Creek along the reservoir face to Ten Mile Creek. The location, varying between elevations 2500 and 2600 is mostly in difficult rock construction, but the minimum log haul construction standard of EE-12 proposed for the section is required to provide an outlet for the timber production from logging unit 108 to water at Dump C.

Route E-N. Protection and administration access from the proposed ranger district headquarters at Eureka, as well as log transportation needs, for the area north of Ten Mile Creek could be provided either by a road location along the reservoir face, or by the "high-country" location as shown on the map of the Study 1 transportation system. The common point for either location is at the mouth of Sutton Creek which would become the focus of both protection and timber-sale activities for the Eureka ranger in administering his area south of Pinkham Creek.

The reservoir face location between Ten Mile Creek and McGuire Creek, the next major side drainage to the north for which a timber outlet must be provided, is predominantly in rock construction. In the interests of holding Study 1 transportation restoration costs to an absolute minimum, the cheaper "high-country" location has been adopted for this study. Although somewhat cheaper, it is necessarily considerably longer because of the extent to which the "high-country" area is broken by irregular topography and the necessity of returning to the reservoir face at Sutton Creek.

Section A, 23.5 miles long, begins at the end of Section F of Route E at the Five Mile Creek summit at elevation 4100. As a minimum construction standard E-12 protection road, it extends to a point below the head of Sutton Creek where it must be of a standard adequate for a log haul. From the Five Mile summit it climbs on a 3.5-percent grade for 6 miles to elevation 5200 at the head of Swamp Creek, then down on an 0.8-percent grade for 3.5 miles to a 5050-foot pass at the head of the north fork of Swamp Creek. From this point it climbs on a 4-percent grade for 2.65 miles to a 5600-foot saddle between Huckleberry and Ten Mile Mountains. It then drops on a 3.8-percent grade for 3.2 miles to a connection with existing forest development road 494 in Section 6, T33N, R27W. The location stays on the existing road for 5.2 miles to the head of Sutton Creek, in Section 18, T34N, R27W (3.8 miles of this portion will need reconstruction to improve it to a satisfactory E-12 standard). The location then drops into the north slope of Sutton Creek on a 7-percent grade for 2.95 miles to the beginning of the Section B log haul road.

Section B from the end of Section A, down Sutton Creek on a general 7-percent grade, to its mouth is 5.7 miles long. In addition to its services to protection and administration needs, Section B would provide the outlet to water at Dump 3 for the timber production from logging unit 106.

Section C, 17.6 miles long, extends from Sutton Creek, north along the reservoir face at approximate elevation 2500 to Pinkham Creek, up Pinkham Creek on a general 2-percent grade to an intersection with existing forest development road 856 in a saddle at elevation 3100, thence to Eureka along the location of existing low standard county roads on a general 2.5-percent downgrade. As planned under Study 1, this section would not be a log haul road. The timber production from Pinkham Creek logging units 104 and 105 would be trucked over existing road 856 to the proposed Dump E near Rexford. Accordingly, it is proposed for a D-16 construction standard (see Section D of Route W) to satisfy protection and administration traffic, as well as its estimated annual use by 2500 recreational cars and 2500 commercial vehicles.

Section D, a 5.5-mile branch off Route E-N, is located at approximate elevation 2500 along the reservoir face, connecting between Sutton Creek and McGuire Creek to the south. It provides for the transportation to Dump 3 of the timber production from logging unit 107.

The total estimated construction and annual costs of the Study 1 transportation system are summarized in table 60. These costs include the roads, trails, and landing field. The table also summarizes the annual drain of timber volumes, both sawlogs and pulpwood, which would be served by the planned road system and by the planned water facilities.

Table 60. Summary of recommended Libby project transportation system restoration costs, except water facilities

Study 1

	Construction		Annual costs			Annual timber volumes served	
	Miles	Cost	Capital	Maintenance	Total	Sawlogs	Pulpwood
	Dollars					Thousand bd.ft.	Cords
Roads							
State Highway 37 relocation	71.6	6,508,076	276,593	60,980	337,573	12,570	18,625
All other	134.55	8,102,414	344,352	33,512	377,864	7,563	11,838
Total	206.15	14,610,490	620,945	94,492	715,437	20,133	30,463
Trails							
T1, T2, T3, T4	53.0	116,600	4,955	1,060	6,015	-	-
Landing field	-	209,330	8,897	1,200	10,097	-	-

It is obvious from an examination of the map in figure 42 that the planned project roads do not provide access to all merchantable timber areas. The timber-production costs of Study 1 include the construction as part of the cost of wood procurement of the following supplementary EE-12 standard roads, which would be needed to provide accessibility to certain bodies of timber.

1. South side of Kootenai River from the load-out facility to Johnson Draw, 7 miles, estimated cost $395,500.

2. West side of Fisher River from Peoples Creek to a connection with Route E near Fawn Creek, 6 miles, estimated cost $106,200.

3. North side of Kootenai River west from Dump 2, 7 miles, estimated cost $154,000.

4. West side of Kootenai River north from Dump 2, 3 miles, estimated cost $132,000.

5. West side of Kootenai River south from Dump A to Little Jackson Creek, 5 miles, estimated cost $77,500.

6. West side of Kootenai River north from Dump A to Geibler Creek, 13 miles, estimated cost $520,000.

The significance of the vehicle miles of use in Study 1 by each of the traffic categories and their transportation costs, compared to the use and cost figures of Studies 2 and 3, is discussed on page 158

Study 2 transportation system

Figure 43 shows the transportation system proposed by Study 2. Its facilities are as follows:

Roads

Route W, Sections A to G, inclusive, provides a yearlong log haul and protection route along the west side of the reservoir from a connection with existing State Highway 37 below the dam to a connection above flowline with the existing road system on the west bank opposite Rexford.

Route S, Sections A and B, the same as proposed for the Study 1 transportation system.

Route P, Sections A to C, inclusive, the same as proposed for the Study 1 transportation system.

Route E, Sections A to G, inclusive, planned as the relocation of State Highway 37, the same as in Study 1.

Route E-N, Sections A to E, inclusive, provides a low-standard route along the east face of the reservoir from the highway connection at Five Mile Creek north to Eureka.

Trails

Because road routes W and E-N are located along the west and east reservoir faces, respectively, the Study 1 trails T-3 and T-4 are supplanted and only the following are needed:

Route T-1, 13.3 miles long, as in Study 1.

Route T-2, 16.7 miles long, as in Study 1.

Landing field

Relocation of the existing field as in Study 1.

Water facilities

Because of less reliance on water transportation to the extent that water is used only where it is the cheapest method of transportation for summer-cut logs, and winter logs will be moved to Libby by the next cheapest method, the Study 2 transportation system requires only two project-financed "permanent" dumps, as follows:

Dump D-A at Pinkham Creek
Dump D-B at Dodge Creek

"Temporary" dumps to be financed by national forest timber sales are required as follows:

Dump D-1 at Buck Creek (west side Fisher River)
Dump D-2 at mouth of Fisher River (east side)
Dump D-3 at Warland Creek
Dump D-4 at Bristow Creek
Dump D-5 at McGuire Creek
Dump D-6 at Big Creek

Project-financed load-out facility upstream from dam, as in Study 1.

Rail facilities

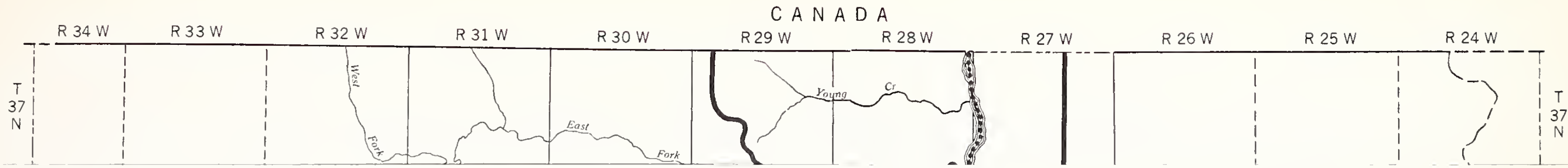
In addition to the four railroad landings proposed in Study 1, Study 2 requires Landing 4 at the mouth of Wolf Creek to provide for the transportation of winter-cut logs and pulpwood from logging units 108 to 113, inclusive. In Study 1, all wood production from these units was moved by water, the cheapest method, deliberately disregarding the resultant effect of seasonal logging on ultimately higher procurement costs.

The relocation under Study 2 of the Study 1 road system to routes generally along the west and east reservoir faces does not change the required post-dam administrative units. The ranger district boundaries, the three proposed ranger stations, and two proposed work centers are the same as proposed in Study 1. It is obvious, however, that with shorter, generally water grade routes, providing direct connections with existing or proposed side drainage roads, the administration and protection job could be handled more efficiently and with lower travel costs.

The cost analysis of the Study 2 road system, developed on the same basis as for Study 1, is given in table 61. Table 62 gives the mode of transport schedule for each logging unit from which the annual timber transportation costs are derived.

The details of route and construction standard selection, as determined by the services required of the route, are explained in the following paragraphs:

Route W. The purpose of this route is not only to provide a through road for fire protection and administration access of the forest area along the west side of the reservoir from Libby to the north end, but also to provide a road which would allow the reasonably economical yearlong trucking of logs and avoid the necessity for a seasonal logging operation. The road would be of a construction standard adequate for the winter trucking by "off-highway" equipment from those logging units along the west side of the reservoir having winter logging chances for a maximum distance of 75 miles from the mill at Libby. To be of satisfactory log haul service, the route must be located where practicable at the lower end of the side drainages, near the reservoir flowline, to avoid adverse haul onto the main road.


CANADA
R 34 W
R 33 W
R 32 W
R 31 W
R 30 W
R 29 W
R 28 W
R 27 W
R 26 W
R 25 W
R 24 W
T 37 N
T 37 N
West Fork
East Fork
Young Cr


CANADA
R 34 W
R 33 W
R 32 W
R 31 W
R 30 W
R 29 W
R 28 W
R 27 W
R 26 W
R 25 W
R 24 W
T 37 N
T 36 N
T 35 N
T 34 N
T 33 N
T 32 N
T 31 N
T 30 N
T 29 N
T 28 N
T 27 N
T 26 N
T 25 N
T 24 N
IDAHO
MONTANA
LINCOLN CO
FLATHEAD CO
SANDERS CO
ZONE OF INFLUENCE BOUNDARY
SUB-ZONE BOUNDARY
ROUTE-EN
ROUTE-W
ROUTE-E
ROUTE S
ROUTE P
PROPOSED LIBBY DAM RIVER MILE 204.9
Kootenai
River
Yaak River
Tobacco
Eureka
REXFORD
UPPER FORD
Mt Henry
Boulder Mtn
Webb Mtn
Lost Horse Mt
BIG CREEK
Pinto Pt
STONEHILL
SYLVANITE
McGuire Mtn
WAREX
Pinkham Mtn
PINKHAM PATROL
ANT FLAT
Murphy Lake
Dickey Lake
Big Creek Baldy Mtn
Zeigler Mt
Sunday Mtn
Upper Stillwater Lake
Banfield Mtn
Blue Mtn
WARLAND
Lindy Pk
TROY
Warland Pk
Boundary Mtn
Davis Mtn
TWIN MEADOWS
Savage Lake
LIBBY
Big Swede
Tony Pk
River view Mtn
Dunn Pk
FAIRVIEW
Horse Hill
STAR MEADOW
Granite Lake
Bull Lake
Fisher Mtn
WOLF CREEK
Island Lake
Calx Mtn
Ashley Lake
Dahl Lake
Horse Mtn
SWAMP CR
Kenelly Mtn
Loon L
Taefeis Pk
RAVEN
WEST FISHER
Thompson Lakes
McGregor Lake
Little Bitterroot Lake
Hubbart Reservoir
BEND
WILLOW CR
CABINET
NATIONAL
FOREST
FLATHEAD NATIONAL FOREST
U.S. FOREST SERVICE
LIBBY DAM PLANNING PROJECT
STUDY 2
TRANSPORTATION SYSTEM RELOCATIONS
-LEGEND-
ROAD CONST. STANDARD
STATE HIGHWAY 37 (PROJECT RESTORATION)
BB28
BB24
FOREST DEVELOPMENT ROADS (PROJECT RESTORATION)
BB28
BB24
DD16
D16
EE12
E12
TRAILS (PROJECT RESTORATION)
WATER TRANSPORTATION FACILITIES
LOADING OUT FACILITY (PROJECT RESTORATION)
PERMANENT DUMP FACILITIES (PROJECT RESTORATION)
TEMPORARY DUMP FACILITIES (NON PROJECT)
GREAT NORTHERN RAILROAD
ASSUMED RELOCATION ROUTE (PROJECT RESTORATION)
TIMBER RELOAD LANDINGS (NON PROJECT)
LANDING FIELD (PROJECT RESTORATION)
ADMINISTRATIVE IMPROVEMENTS
PROPOSED RANGER STATION (PROJECT RESTORATION)
PROPOSED WORK CENTER (PROJECT RESTORATION)
REVISED RANGER DISTRICT BOUNDARIES

Figure 43

Table 61. Summary of road system cost analyses

Study 2

	Unit	Route						Entire system
		W	W-N	S	P	E	E-N	
Length	Miles	64.0	-	2.9	9.25	71.6	37.0	184.75
Total construction cost	Dollars	6,533,009	-	408,697	160,469	7,107,323	2,695,451	16,904,949
Annual road cost								
Construction	Dollars	277,653	-	17,370	6,820	302,061	114,557	718,461
Maintenance	Dollars	39,242	-	1,820	833	62,580	5,768	110,243
Total	Dollars	316,895	-	19,190	7,653	364,641	120,325	828,704
Annual transportation cost								
Wood products	Dollars	61,036	-	15,158	-	48,382	15,520	140,096
Mineral products	Dollars	91,444	-	-	-	-	-	91,444
Recreational travel	Dollars	64,494	-	4,524	1,111	394,290	8,014	472,434
Commercial travel	Dollars	63,486	-	6,160	-	342,535	9,652	421,833
National forest administration	Dollars	16,723	-	536	866	15,731	8,084	41,940
Total	Dollars	297,184	-	26,378	1,977	800,938	41,270	1,167,747
Total annual road and transportation cost	Dollars	614,079	-	45,568	9,630	1,165,579	161,595	1,996,451

Table 62. Annual cut by logging units and mode of transporting wood[1]

Study 2

Logging unit	Summer cutting: Sawlogs	Summer cutting: Pulpwood	Summer cutting: Mode of transport	Winter cutting: Sawlogs	Winter cutting: Pulpwood	Winter cutting: Mode of transport
	Thousand bd.ft.	Cords		Thousand bd.ft.	Cords	
			Libby group			
80	212	368	Truck via Route W	-	-	-
81	676	1,059	Truck via Route W	-	-	-
82	353	534	Truck to water - no planned dump	-	-	-
84	561	917	Truck to water - no planned dump	-	-	-
113	1,224	2,023	Truck to Dump 2	511	712	Truck-rail via Landing 4
179	761	1,136	Truck to Libby via lift-out	-	-	-
			Warland group			
85	171	312	Truck to water - no planned dump	-	10	-
86	354	614	Truck via Route W	489	847	Truck via Route W
87	479	823	Truck via Route W	434	744	Truck via Route W
88	744	1,177	Truck to Dump 4	611	1,050	Truck via Route W
89	438	759	Truck to Dump 4	-	-	-
108	111	-	Truck to water - no planned dump	-	-	-
108	1,002	1,906	Truck to Dump 3	141	68	Truck-rail via Landing 4
109	1,202	1,974	Truck to Dump 3	233	212	Truck-rail via Landing 4
110	195	470	Truck to Dump 3	411	498	Truck-rail via Landing 4
111	1,164	1,994	Truck to Dump 3	695	1,114	Truck-rail via Landing 4
112	571	1,214	Truck to Dump 3	496	768	Truck-rail via Landing 4
			Stonehill group			
90	566	889	Truck to Dump 6			
91	621	1,133	Truck to Dump 6			
94	700	1,250	Truck to Dump 6			
97	716	1,007	Truck to Dump 6			
98	453	808	Truck to Dump 6			
106	1,641	2,160	Truck to Dump A			
107	905	1,717	Truck to Dump 5			
			Rexford group			
99	973	895	Truck to Dump B	-	-	-
100	669	932	Truck to Dump B	474	615	Truck via Route W
101	387	555	Truck to Dump B	332	476	Truck via Route W
102	769	1,119	Truck to Dump B	754	1,221	Truck via Route W
103	659	891	Truck to Dump A	940	1,318	Truck-rail via Eureka
104	207	249	Truck to Dump A	1,139	1,367	Truck-rail via Eureka
105	925	839	Truck to Dump A	670	603	Truck-rail via Eureka
			Lower Fisher group			
151[2]	385	459	Truck via Route E	134	183	Truck via Route E
152	429	480	Truck to Dump 2	90	108	Truck via Route E
153	283	353	Truck to Dump 1	62	83	Truck via Route E
154	390	308	Truck to Dump 1	235	205	Truck via Route E
155	194	354	Truck to Dump 1	438	507	Truck via Route E
			Mid-Fisher group			
149[2]	595	754	Truck via Route E	113	143	Truck via Route E
156	401	402	Truck via Route E	236	237	Truck via Route E
157	217	213	Truck via Route E	67	65	Truck via Route E
158	226	209	Truck via Route E	149	137	Truck via Route E
160	671	758	Truck via Route E	204	231	Truck via Route E
161	247	257	Truck via Route E	70	73	Truck via Route E
162	282	294	Truck-rail via Landing 5	154	199	Truck-rail via Landing 5
163	489	465	Truck-rail via Landing 5	122	116	Truck-rail via Landing 5
			Upper Fisher group			
174	850	1,284	Truck-rail via Landing 5	102	154	Truck-rail via Landing 5
164	30	24	Truck-rail via Landing 5	114	89	Truck-rail via Landing 5
165	316	259	Truck-rail via Landing 5	376	307	Truck-rail via Landing 5
166	272	204	Truck-rail via Landing 5	408	305	Truck-rail via Landing 5
167	475	869	Truck-rail via Landing 5	119	217	Truck-rail via Landing 5
168	1,569	2,639	Truck-rail via Landing 5	11	18	Truck-rail via Landing 5
169	1,951	3,268	Truck-rail via Landing 5	-	-	-
170	471	549	Truck-rail via Landing 5	23	27	Truck-rail via Landing 5
171	1,588	2,403	Truck-rail via Landing 5	-	-	-
172	1,031	1,134	Truck-rail via Landing 5	437	482	Truck-rail via Landing 5
173	431	307	Truck-rail via Landing 5	204	143	Truck-rail via Landing 5
			Wolf Creek group			
139	2,270	3,515	Truck-rail via Landing 1	-	-	-
140	1,039	1,517	Truck-rail via Landing 2	460	671	Truck-rail via Landing 2
141	436	531	Truck-rail via Landing 2	76	92	Truck-rail via Landing 2
142	1,479	1,320	Truck-rail via Landing 2	531	532	Truck-rail via Landing 2
143	327	493	Truck-rail via Landing 2	306	461	Truck-rail via Landing 2
144	1,530	1,807	Truck-rail via Landing 3	429	506	Truck-rail via Landing 3
150[2]	756	692	Truck via Route E	230	210	Truck via Route E
Total for zone of influence (except logging units 92, 93, 95, 96)	42,039	59,845		14,230	18,124	

1/From those logging units where it is the cheapest method, water is to be used to transport summer cutting. Winter cutting from those units is to be transported by the next cheapest available method in order to provide a yearlong log supply to Libby.

2/Logging units 151, 149, and 150 indicate slight advantage to rail transportation, and decision to route by truck directly to Libby is based on providing increased flexibility of operation.

Under the Study 2 road system, Route W would provide a year-round outlet for the 15 or so families residing in the Tooley Lake area, but as mentioned, at the expense of a 140-mile round-trip to Libby. Compared to their proximity to their present trading centers at Rexford and Eureka (8 and 18 miles, respectively), the Study 2 system would be deficient in serving these people.

Section A, 2.2 miles long, is on the same location and is proposed for the same construction standard (BB-28) as Section A of Route W of Study 1.

Section B, 3.2 miles long, likewise is proposed for a BB-28 construction standard and is on the same location as Section B of Study 1, except that it terminates at Rainy Creek.

Section C, 1.0 mile long, is on the location and to the BB-28 construction standard of the last mile of Section B of Study 1.

Section D is on the location of Sections C and D of Study 1 except that it extends beyond Bristow Creek to approximate elevation 2660 on the southeast face of Ziegler Mountain above the reservoir, a total length of 23.1 miles. Section D would serve the all-year transportation to Libby of timber from logging units 81, 86, 87, and 88 as well as the winter transportation of timber from units 100, 101, and 102, a total annual drain volume of 4600 thousand board feet of sawlogs and 7450 cords of pulpwood. Public travel on this utilization road is estimated at 4500 recreational cars and 2500 commercial vehicles a year, the same as in Study 1. A DD-16 construction standard, with turnouts as specified, is proposed as the minimum adequate for the combined use.

One objective of Route W is to provide a reasonably economical log haul road. Since Section D incurs adverse haul grades of 1.7 percent in climbing over the Rainy Creek-Jackson Creek summit at elevation 3850, and in doing so remains at high elevation for a considerable distance, it becomes necessary to consider an alternate location along the reservoir face between Rainy Creek and the southeast face of Ziegler Mountain. This alternate location was not considered in Study 1 because of the very heavy rock construction involved, particularly from the Big Bend north to Little Jackson Creek, and the fact that in Study 1, Section D was not to be used for log haul.

Route W-A, the alternate to Sections C and D above, was analyzed and rejected. It extends between common points at Rainy Creek and the southeast face of Ziegler Mountain. The comparison of the two alternate locations is shown on sheet 1 of table 61. Although but 1.0 mile longer, Route W-A, to the same DD-16 construction standard, is estimated to cost $877,521 more than the total of Sections C and D. Also, Sections C and D provide a considerably shorter haul route for the timber from logging units

86, 87, and 88 so that despite a higher haul cost per thousand board feet a mile and despite somewhat less timber volume made accessible, the net result is in favor of Sections C and D by the difference between annual sawlog transportation costs of $3.41 a thousand board feet and $3.67 a thousand board feet. It is planned that the annual drain of 1085 thousand board feet of sawlogs and 1773 cords of pulpwood from logging units 82, 84, and 85, not made accessible by Sections C and D, would be trucked to water during full reservoir periods when special log handling equipment would not be required. Since there are no winter logging areas in these three units, and since they contribute a relatively small volume of timber, it is considered that the heavy expense of a main haul road or dump facilities to fully develop them cannot be justified.

Section E, is 10.8 miles long, extending from the southeast face of Ziegler Mountain, to the mouth of Parsnip Creek, where it joins the location of Section G of Route W of Study 1. Along an area of heavy rock construction, Section E is located generally between elevations 2660 and 2550 to take maximum advantage of less difficult topography. This section serves as an access to Dump 4 for the timber production from logging unit 89 and for the transportation of winter logging timber to Libby from north end units 100, 101, and 102. To accommodate this log haul traffic, in addition to an estimated annual volume of 2500 recreational and 1000 commercial vehicles, a DD-16 construction standard is proposed.

Section F, 8.2 miles long, from Parsnip Creek to Big Creek, is on the same location as the corresponding length of Section G of Route W of Study 1. In addition to the winter haul of timber from units 100, 101, and 102, it would serve as an access to Dump 6 for the timber production from logging units 91, 94, 97, and 98, and is proposed for a DD-16 construction standard.

Section G is 15.5 miles long, extending from Big Creek north to a connection with Yaak River-west side forest development road 92, at approximate elevation 2600 in Section 16, T36N, R28W. It is on the same location as Sections H, I, and J of Route W of Study 1. Section G is proposed for a DD-16 construction standard to accommodate "off-highway" log trucks from logging units 97 and 98 to Dump 6, from 99 and 100 to Dump B, and for the winter cut from 100, 101, and 102 to Libby.

Route S, Sections A and B, a total length of 2.9 miles, is on the same location, provides the same service, and is proposed for the same construction standard (BB-28) as Route S of Study 1.

Route P, Sections A, B, and C, a total length of 9.25 miles, is the same as described for Route P of Study 1.

Route E, Sections A to G inclusive, is the State Highway 37 restoration route of Study 2. It is on the same location as in Study 1, and except for timber transportation provides the same services, including administration access to the proposed Wolf Creek Ranger Station at the end of Section B.

Because a stated objective of the Study 2 transportation system is to provide for the transportation to Libby of winter logs, appreciably more timber would be hauled over Sections A, B, and C of Route E in Study 2 than in Study 1.

The total annual road and transportation costs of Sections A, B, and C for the BB-24 construction standard are $571,554, and for the BB-28 standard $592,443, a difference in favor of the BB-24 of $20,889 annually. At the same time, the BB-28 standard shows an annual savings of $6179 in timber transportation costs. The BB-28 construction standard is being recommended for these sections because of this savings in timber haul costs at the penalty of but a 3½-percent increase in total costs, plus the following factors:

1. "Off-highway" equipment would be in general use in the Wolf Creek, mid-Fisher, and Upper Fisher areas in trucking from the woods over forest development roads to the respective railroad landings. A restriction of the use of "on-highway" equipment for the haul to Libby on portions of relocated State Highway 37 would impose an unjust burden on the timber operator by requiring that he operate dual fleets of "on-highway" and "off-highway" equipment from the same areas.

2. There is an existing private road paralleling US Highway 2 between Libby and the proposed junction with Highway 37. Thus it would not be necessary to operate the "off-highway" equipment which is not constructed for that purpose.

3. A 28-foot surfaced width would provide a safer highway for combined use by relatively heavy volumes of both log haul and public traffic.

4. The postdam transportation system has the obligation of holding wood-procurement costs as reasonably close to Study 0 costs as practicable. Comparative cost analyses of individual road sections are a guide to the construction standard that can be recommended. However, it is the cost of the overall transportation system that, in the final analysis, is subject to economic justification.

The remaining length of Route E, over Sections D, E, F, and G, a total of 39.6 miles, is on the same location and is proposed for the same construction standard (BB-24) as Sections D, E, F, and G of Study 1. Under the Study 2 timber operating plan, however, Sections D and E provide somewhat greater service to timber transportation since winter logs from logging units 108, 109, 110, 111, and 112 are trucked over these sections to railroad Landing 4 at the mouth of Wolf Creek.

Route E-N, 37.4 miles long, is in effect the reservoir face alternate to the "ridge-top" location of Route E-N and the reservoir face location of Section H of Route E of Study 1, a total length of 56.8

miles. In addition to providing an outlet for timber areas along the east face of the reservoir north of Five Mile Creek, the Study 2 route is of greater service to fire protection and administration needs than the Study 1 route.

Section A, 4.5 miles long, from Five Mile Creek to Ten Mile Creek, is on the same location, provides the same service, and is proposed for the same EE-12 construction standard as Section H of Route E of Study 1.

Section B, 10.0 miles long, extends from Ten Mile Creek to McGuire Creek. Since the timber production from logging unit 107 would be placed in the water at Dump 5 at the mouth of McGuire Creek, the necessary service of this section is limited principally to fire protection, administration, and management access to logging unit 107 from either the north or south. For this service along an area of particularly heavy rock construction, an E-12 construction standard with specified turnouts is considered adequate.

Section C, 5.5 miles long, extends from McGuire Creek to Sutton Creek. Like Section B, the construction is difficult and no log haul transportation is planned over it. It is likewise proposed for an E-12 construction standard.

Section D, 6.5 miles long, extends from Sutton Creek across the mouth of Pinkham Creek to the permanent log-handling facility at Dump A to which the timber production from logging unit 106 is to be trucked. The construction is particularly difficult along the first four miles of the section and, in view of the relatively small estimated use by public traffic, a minimum EE-12 log haul construction standard is proposed.

Section E, 10.9 miles long, extends from Dump A up Pinkham Creek to Eureka on the same location as the corresponding length of Section C of Route E-N of Study 1. Section E is an important link in the log haul transportation. It provides the outlet to Dump A of the summer production of timber from logging units 103, 104, and 105, as well as to Eureka for reload onto rail of the considerable volume of winter production from these same units. Accordingly, its construction standard is raised from the D-16 of Study 1 to a DD-16.

The total construction and annual costs of the Libby project transportation restoration responsibilities for Study 2 are summarized in table 63. It also summarizes the annual drain timber volumes served by the planned road system.

The deficiency of the Study 2 transportation system in providing access to logging units 86, 87, and 88 has already been discussed. Its deficiency with respect to other units is to be made up by the timber-financed construction of supplementary EE-12 roads. The cost of the following roads has been included in calculating wood-procurement costs under Study 2.

1. South side of Kootenai River from the load-out facility 3 miles upstream, estimated cost $169,500.

2. South side of Kootenai River and west side of Fisher River from Johnson Draw to a connection with Section B of Route E near the confluence of Wolf Creek, 14 miles, estimated cost $247,800.

Table 63. Summary of recommended Libby project transportation system restoration costs, except water facilities

Study 2

	Construction		Annual costs			Annual timber volumes served	
	Miles	Cost	Capital	Maintenance	Total	Sawlogs	Pulpwood
	Dollars					Thousand bd.ft.	Cords
Roads							
State Highway 37 relocation	71.6	7,107,323	302,061	62,580	363,641	14,806	22,165
All other	113.15	9,797,626	416,400	47,663	464,063	17,232	25,473
Total	184.75	16,904,949	718,461	110,243	828,704	32,038	47,638
Trails							
T1, T2	30.0	66,000	2,805	600	3,405	-	-
Landing field	-	209,330	8,897	1,200	10,097	-	-

The significance of the vehicle miles of use in Study 2 by each of the traffic categories and their transportation costs, compared to the use and cost figures of Studies 1 and 3, is discussed on page 158.

Study 3 transportation system

Figure 44 shows the transportation system as proposed by Study 3. Its facilities are as follows:

Roads

Route W, Sections A to I, inclusive, planned as the relocation of State Highway 37, and calling for a bridge crossing of the reservoir (Section H) in the vicinity of Webb Mountain.

Route W-N provides a log haul road on the west side of the reservoir connecting Route W at the proposed bridge with the existing road system above flowline on the west bank opposite Rexford.

Route S, Sections A and B, the same as proposed for the Studies 1 and 2 transportation systems.

Route E, Sections A to I, inclusive, provides a log haul and protection road along the east face of the reservoir, connecting with Route W at the proposed bridge.

Route P, Sections A to C, inclusive, the same as proposed for the Studies 1 and 2 transportation systems.

Trails

As in Study 2, only the following trails are required to provide a type of access to reservoir face areas not served by planned roads:

Route T-1, 13.3 miles long, as in Studies 1 and 2.

Route T-2, 16.7 miles long, as in Studies 1 and 2.

Landing field

Relocation of the existing field as in Studies 1 and 2.

Water facilities

Because the winter production of timber from logging units at the northwest end of the reservoir can be trucked across the proposed reservoir bridge, the Study 3 transportation system requires only one project-financed "permanent" dump as follows:

Dump D-A at Pinkham Creek

"Temporary" dumps to be financed by national forest timber sales are required as follows:

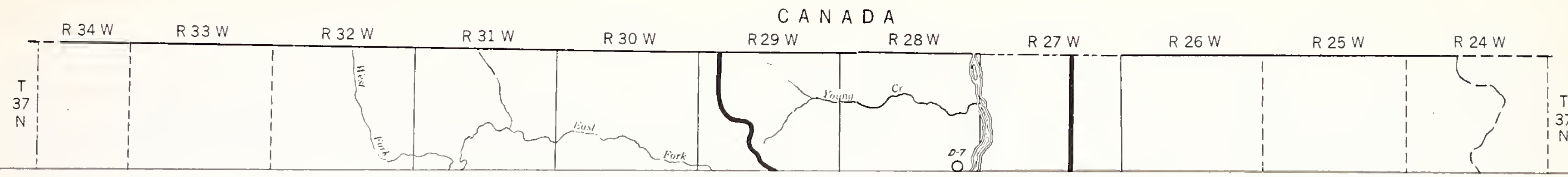
Dump D-1 at Buck Creek (west side Fisher River)
Dump D-2 at mouth of Fisher River (east side)
Dump D-3 at Warland Creek
Dump D-4 at Bristow Creek
Dump D-5 at McGuire Creek
Dump D-6 at Big Creek
Dump D-7 at Dodge Creek

Project-financed load-out facility upstream from dam, as in Studies 1 and 2.

Rail facilities

Railroad landings along the proposed location of the Great Northern Railway to be financed by national forest and/or private timber operations, as follows:

Landing 1 at Upper Wolf Creek
Landing 2 at Wolf Prairie
Landing 3 at Tamarack Creek
Landing 4 at mouth of Wolf Creek
Landing 5 at Fisher River on US Highway 2


CANADA
R 34 W
R 33 W
R 32 W
R 31 W
R 30 W
R 29 W
R 28 W
R 27 W
R 26 W
R 25 W
R 24 W
T 37 N
West Fork
East Fork
Young Cr
D-7
T 37 N


CANADA
R 34 W
R 33 W
R 32 W
R 31 W
R 30 W
R 29 W
R 28 W
R 27 W
R 26 W
R 25 W
R 24 W
T 37 N
T 36 N
T 35 N
T 34 N
T 33 N
T 32 N
T 31 N
T 30 N
T 29 N
T 28 N
T 27 N
T 26 N
T 25 N
T 24 N
IDAHO
MONTANA
Eureka
REXFORD
ROUTE-WN
ROUTE-W
ROUTE-E
ROUTE S
ROUTE P
ZONE OF INFLUENCE BOUNDARY
SUB-ZONE BOUNDARY
PROPOSED LIBBY DAM RIVER MILE 204.9
LIBBY
Kootenai
River
TROY
SYLVANITE
UPPER FORD
Mt Henry
Boulder Mln
Lost Horse Mtn
BIG CREEK
Pinto Pt
Webb Mtn
McGuire Mtn
Big Creek Baldy Mtn
Zeigler Mtn
Banfield Mtn
Blue Mtn
Lindy Pk
WARLAND
Warland Pk
Davis Mtn
TWIN MEADOWS
Boundary Mtn
Big Swede
River view Mtn
Dunn Pk
Horse Hill
Fisher Mtn
WOLF CREEK
Calx Mtn
Horse Mtn
SWAMP CR
Kenelty Mtn
Teeters Pk
RAVEN
WEST FISHER
Loon L
McGregor Lake
Hubbart Reservoir
BENO
WILLOW CR
Pinkham Mtn
PINKHAM PATROL
ANT FLAT
Murphy Lake
Sunday Mtn
Glen Lake
Tobacco
STAR MEADOW
Island Lake
FLATHEAD NATIONAL FOREST
CABINET NATIONAL FOREST
FLATHEAD CO
SANDERS CO
LINCOLN CO
U.S. FOREST SERVICE
LIBBY DAM PLANNING PROJECT
STUDY 3
TRANSPORTATION SYSTEM RELOCATIONS
-LEGEND-
ROAD CONST. STANDARD
STATE HIGHWAY 37 (PROJECT RESTORATION)
BB28
BB24
FOREST DEVELOPMENT ROADS (PROJECT RESTORATION)
BB28
BB24
DD16
D16
EE12
E12
TRAILS (PROJECT RESTORATION)
WATER TRANSPORTATION FACILITIES
LOADING OUT FACILITY (PROJECT RESTORATION)
PERMANENT DUMP FACILITIES (PROJECT RESTORATION)
TEMPORARY DUMP FACILITIES (NON PROJECT)
GREAT NORTHERN RAILROAD
ASSUMED RELOCATION ROUTE (PROJECT RESTORATION)
TIMBER RELOAD LANDINGS (NON PROJECT)
LANDING FIELD (PROJECT RESTORATION)
ADMINISTRATIVE IMPROVEMENTS
PROPOSED RANGER STATION (PROJECT RESTORATION)
PROPOSED WORK CENTER (PROJECT RESTORATION)
REVISED RANGER DISTRICT BOUNDARIES

Figure 44

The Study 3 map shows that, due to the availability of a reservoir crossing at the north end, only a minor realignment of ranger district boundaries would be required. The additional district required by the Studies 1 and 2 transportation systems is not necessary. The restoration of the inundated Warland and Rexford Ranger Stations at Wolf Creek and Eureka, respectively, in addition to work centers at Warland Creek, Bristow Creek, and Big Creek would maintain the effectiveness of the present administrative organization with negligible loss of efficiency.

In examining the map of the Study 3 transportation system, these important advantages as compared to the road systems of Studies 1 and 2 are to be noted:

1. The relocation of State Highway 37 is integrated with required log haul and protection roads resulting in less total mileage to be constructed (see page 158 for comparisons).

2. A direct highway route with no high passes or consequent heavy winter maintenance is provided between Libby and Eureka. This highway route would result in significant savings in public travel costs, would have a maximum scenic value, and give excellent service to timber transportation.

3. This plan has a maximum distance of high standard road along the reservoir face with consequent advantages to the speed with which men, equipment, and supplies could be dispatched to fires.

4. It provides a maximum accessibility of both summer and winter timber areas to whichever is the most economical transportation medium, water, rail, or road, at resultant wood-procurement costs most comparable to those of Study 0.

5. With a reservoir bridge crossing near Webb Mountain, a satisfactory outlet would be provided to Eureka for the families in the Tooley Lake area.

The cost analysis of the Study 3 road system is given in table 64. In this case economic road and transportation cost comparisons are made for all sections of the important routes except Sections A, B, and C of Route W, the construction standard of which is predetermined by the combined requirements of wood and mine products haul and public traffic. Based on the road construction cost estimates given in table 47, and the transportation costs for the estimated volume of each kind of traffic, the economic cost comparisons are generally made between three road construction standards, showing which standard results in the most economical total annual road and transportation cost. The annual timber-haul costs for these calculations are derived from the schedule of table 65, which shows the mode of transport for each logging unit as determined from the analysis of timber production costs. Where a standard other than that indicated to be the most economical is recommended, the reasons for the departure are explained in the following discussion.

Table 64. Summary of road system cost analyses

Study 3

	Unit	Route						Entire system
		W	W-N	S	P	E	E-N	
Length	Miles	70.7	7.5	2.9	9.25	68.8	-	159.15
Total construction cost	Dollars	16,522,467	703,778	408,697	160,469	4,921,855	-	22,717,266
Annual road cost								
Construction	Dollars	702,205	29,911	17,370	6,820	209,178	-	965,474
Maintenance	Dollars	81,790	3,750	1,820	833	34,872	-	123,065
Total	Dollars	783,995	33,661	19,190	7,653	244,050	-	1,088,549
Annual transportation cost								
Wood products	Dollars	30,537	4,598	14,477	-	62,540	-	112,152
Mineral products	Dollars	91,444	-	-	-	-	-	91,444
Recreational travel	Dollars	524,189	9,750	4,524	1,111	22,620	-	562,194
Commercial travel	Dollars	565,732	3,938	6,160	-	19,992	-	595,822
National forest administration	Dollars	16,147	1,181	536	866	14,866	-	33,596
Total	Dollars	1,228,049	19,467	25,697	1,977	120,018	-	1,395,208
Total annual road and transportation cost	Dollars	2,012,044	53,128	44,887	9,630	364,068	-	2,483,757

Table 65. Annual cut by logging units and mode of transporting wood[1]

Study 3

Logging unit	Summer cutting: Sawlogs	Summer cutting: Pulpwood	Summer cutting: Mode of transport	Winter cutting: Sawlogs	Winter cutting: Pulpwood	Winter cutting: Mode of transport
	Thousand bd.ft.	Cords		Thousand bd.ft.	Cords	
			Libby group			
80	212	368	Truck via Routes W and S	-	-	-
81	676	1,059	Truck via Routes W and S	-	-	-
82	353	534	Truck to water - no planned dump	-	-	-
84	561	917	Truck to water - no planned dump	-	-	-
113	1,224	2,023	Truck to Dump 2	511	712	Truck-rail via Landing 4
179	761	1,136	Truck via Route S	-	-	-
			Warland group			
85	171	312	Truck to water - no planned dump	-	10	-
86	354	614	Truck via Route W	489	847	Truck via Route W
87	479	823	Truck via Route W	434	744	Truck via Route W
88	744	1,177	Truck to Dump 4	611	1,050	Truck via Route W
89	438	759	Truck to Dump 4	-	-	-
108	111	-	Truck to water - no planned dump	-	-	-
108	1,002	1,906	Truck to Dump 3	141	68	Truck-rail via Landing 4
109	1,202	1,974	Truck to Dump 3	233	212	Truck-rail via Landing 4
110	195	470	Truck to Dump 3	411	498	Truck-rail via Landing 4
111	1,164	1,994	Truck to Dump 3	695	1,114	Truck-rail via Landing 4
112	571	1,214	Truck to Dump 3	496	768	Truck-rail via Landing 4
			Stonehill group			
90	566	889	Truck to Dump 6			
91	621	1,133	Truck to Dump 6			
94	700	1,250	Truck to Dump 6			
97	716	1,007	Truck to Dump 6			
98	453	808	Truck to Dump A			
106	1,641	2,160	Truck to Dump A			
107	905	1,717	Truck to Dump 5			
			Rexford group			
99	973	895	Truck to Dump A	-	-	-
100	669	932	Truck to Dump 7	474	615	Truck-rail via Eureka
101	387	555	Truck to Dump 7	332	476	Truck-rail via Eureka
102	769	1,119	Truck to Dump 7	754	1,221	Truck-rail via Eureka
103	659	891	Truck to Dump A	940	1,318	Truck-rail via Eureka
104	207	249	Truck to Dump A	1,139	1,367	Truck-rail via Eureka
105	925	839	Truck to Dump A	670	603	Truck-rail via Eureka
			Lower Fisher group			
151[2]	385	459	Truck via Route E	134	183	Truck via Route E
152	429	480	Truck to Dump 2	90	108	Truck via Route E
153	283	353	Truck to Dump 1	62	83	Truck via Route E
154	390	308	Truck to Dump 1	235	205	Truck via Route E
155	194	354	Truck to Dump 1	438	507	Truck via Route E
			Mid-Fisher group			
149[2]	595	754	Truck via Route E	113	143	Truck via Route E
156	401	402	Truck via Route E	236	237	Truck via Route E
157	217	213	Truck via Route E	67	65	Truck via Route E
158	226	209	Truck via Route E	149	137	Truck via Route E
160	671	758	Truck via Route E	204	231	Truck via Route E
161	247	257	Truck via Route E	70	73	Truck via Route E
162	282	294	Truck-rail via Landing 5	154	199	Truck-rail via Landing 5
163	489	465	Truck-rail via Landing 5	122	116	Truck-rail via Landing 5
			Upper Fisher group			
174	850	1,284	Truck-rail via Landing 5	102	154	Truck-rail via Landing 5
164	30	24	Truck-rail via Landing 5	114	89	Truck-rail via Landing 5
165	316	259	Truck-rail via Landing 5	376	307	Truck-rail via Landing 5
166	272	204	Truck-rail via Landing 5	408	305	Truck-rail via Landing 5
167	475	869	Truck-rail via Landing 5	119	217	Truck-rail via Landing 5
168	1,569	2,639	Truck-rail via Landing 5	11	18	Truck-rail via Landing 5
169	1,951	3,268	Truck-rail via Landing 5	-	-	-
170	471	549	Truck-rail via Landing 5	23	27	Truck-rail via Landing 5
171	1,588	2,403	Truck-rail via Landing 5	-	-	-
172	1,031	1,134	Truck-rail via Landing 5	437	482	Truck-rail via Landing 5
173	431	307	Truck-rail via Landing 5	204	143	Truck-rail via Landing 5
			Wolf Creek group			
139	2,270	3,515	Truck-rail via Landing 1	-	-	-
140	1,039	1,517	Truck-rail via Landing 2	460	671	Truck-rail via Landing 2
141	436	531	Truck-rail via Landing 2	76	92	Truck-rail via Landing 2
142	1,479	1,320	Truck-rail via Landing 2	531	532	Truck-rail via Landing 2
143	327	493	Truck-rail via Landing 2	306	461	Truck-rail via Landing 2
144	1,530	1,807	Truck-rail via Landing 3	429	506	Truck-rail via Landing 3
150[2]	756	692	Truck via Route E	230	210	Truck via Route E
Total for zone of influence (except logging units 92, 93, 95, 96)	42,039	59,845		14,230	18,124	

1/From those logging units where it is the cheapest method, water is to be used to transport summer cutting. Winter cutting from those units is to be transported by the next cheapest available method in order to provide a yearlong log supply to Libby.

2/Logging units 151, 149, and 150 indicate slight advantage to rail transportation, and decision to route by truck directly to Libby is based on providing increased flexibility of operation.

Route W. State Highway 37 relocation route of Study 3 is on the same location as Route W of Study 2 as far north as the proposed Webb Mountain reservoir bridge site. At this point it crosses to the east face of the reservoir, turns north to Pinkham Creek, up Pinkham Creek to a 3100-foot saddle, and then down to Eureka. The basis for the estimate of through public traffic on the vehicles has been discussed on page 104.

Sections A, B, and C, as in Studies 1 and 2, are recommended for a BB-28 construction standard as they would carry an estimated 88,200 recreational and 67,000 commercial vehicles a year, in addition to a heavy logging traffic.

Section D, 23.1 miles long, with the same termini as the Section D of Route W of Study 2, is recommended for a BB-28 construction standard in view of its use as a through haul road to Libby from logging units 81, 86, 87, and 88, although the cost analysis favors the BB-24 standard. The indicated annual savings of $1973 in timber-transportation costs, because of the allowed use of "off-highway" log trucks, is one reason for this recommendation. More important, however, are the factors already discussed in the construction standard selections for Route E of Study 2 (1) that off-highway" equipment would be in general use in adjacent areas in trucking wood products to water dumps and a restriction to the use of "on-highway" equipment for the through haul to Libby would impose on the logging operation the added costs of a dual fleet of trucks; (2) the "off-highway" equipment would travel only on roads constructed as reservoir restoration projects and built for specific use as heavy-duty haul roads; (3) the 28-foot surfaced width would provide a safer highway for combined use by log haul and public traffic; and (4) it is the overall cost of the transportation system that must finally be subjected to economic justifications--not individual sections of road. Over this section away from the dam and reservoir, the estimated public traffic drops to 75,000 recreational cars and 55,000 commercial vehicles a year.

Route W-A, 25.1 miles long, was analyzed and rejected. It is the reservoir face alternate location to Sections C and D of Route W and a comparative cost analysis was made for the reasons discussed for the same alternate in Study 2. In this case the total annual road and transportation costs of $600,685 for Route W-A to a BB-24 standard against $536,641 ($550,929 - $14,288 annual Zonolite transportation costs to put the two alternates on the same service basis) for combined Sections C and D to a BB-28 standard unquestionably support the selection of the Sections C and D. Included in these total annual road and transportation cost comparisons is an allowance of $18,825 for annual maintenance costs of the reservoir face location of Route W-A against $24,100 for the higher elevation location and consequently higher snow removal costs of Sections C and D.

The selection of the Section C and D alternative is confirmed by the further analysis which shows an annual unit sawlog-transportation cost of $2.39 a thousand board feet via Route W-A against $1.82 a thousand board feet via Sections C and D.

Section E, 10.8 miles long, is on the same location as Section E of Route W of Study 2. Public traffic is estimated at 60,000 recreational cars and 45,000 commercial vehicles annually. The section serves as an access to Dump 4 for the timber production from logging unit 89. With only $125 difference in annual timber-hauling costs as between a BB-24 and a BB-28 construction standard, the BB-24 standard is recommended as shown by its total annual road and transportation cost savings of $17,864 compared to a CC-20 standard, and $21,114 compared to a BB-28 standard.

Section F is 8.2 miles long on the same location as Section F of Route W of Study 2. Public traffic is estimated at 60,000 recreational cars and 45,000 commercial vehicles annually. The timber production from logging units 91, 94, and 97 would be trucked over this section to Dump 6. As in Section E, with only $277 difference in annual timber-transportation costs, the BB-24 construction standard is recommended on the basis of its showing of lowest total annual road and transportation costs.

Section G, 8.0 miles long, extends from Big Creek to the proposed reservoir bridge near Webb Mountain. Recreational and commercial traffic is estimated as the same as over preceding Sections E and F. The timber production from logging unit 97 would be trucked over part of the section to Dump 6 and from logging unit 98 over part of the section to Dump A. Again, with a small difference in annual timber-transportation costs, the BB-24 construction standard is recommended on the basis of its showing of lowest total annual road and transportation costs.

Section H is the proposed reservoir bridge crossing. Its site in the NW$\frac{1}{4}$, Section 13, T35N, R29W, has been tentatively selected, subject to confirmation by adequate subsurface exploration, on the basis of (1) least overall length; (2) apparently satisfactory foundation conditions; (3) satisfactory location to traffic requirements; and (4) satisfactory approach alignment. Although bedrock is exposed on both the west and east canyon walls at the Webb Mountain site, no outcroppings are evident in the valley bottom at the immediate site. However, bedrock outcrops do appear on the valley bottom up and down stream from the site, and although no definite pattern is apparent, it is assumed that bedrock foundation for piers can be reached at reasonable cost.

The deck elevation for the bridge is tentatively set at elevation 2530. Allowing 30 feet for depth of structure at midspan, this provides a navigation clearance of 41 feet at full reservoir elevation 2459. Accordingly, the height of deck above the present valley bottom is approximately 280 feet.

By triangulation, the distance between canyon walls at elevation 2530 has been calculated as 2041 feet. The cost estimates for the bridge are based on a cantilever type structure with an overall length of 2100 feet and a tentative span layout of 650 feet-800 feet-650 feet.

Because of our little experience with structures of this height and length, the advice of Mr. R. A. Stephenson, Bridge Engineer for the Montana District of the Bureau of Public Roads, was obtained in preparing the cost estimates for the bridge. These estimates are based (1) on a design for AASHO H20-S16 loading with a 24-foot roadway; and (2) on a design for a modified H30-S24 loading with a 28-foot roadway. The modified H30-S24 loading consists of the following loads: an H30-S24 truck loading or an H20-S16 lane loading (uniform load of 640 pounds per linear foot of traffic lane plus a concentrated load of 18,000 pounds for moment calculations and 26,000 pounds for shear calculations), applied in accordance with the American Association of State Highway Officials (AASHO) Standard Specifications for Highway Bridges.

As shown in table 47 and again in the road system cost analyses of Study 3 (table 64), the estimated cost of the bridge is as follows:

H20-S16 loading, 24-foot roadway	$3,740,000
H30-S24 loading (modified), 28-foot roadway	4,180,000

These estimates are believed to be reliable in the presentation of a correct comparison of the transportation costs of Study 3. However, one should realize the limitations of the estimates, prepared without an accurate knowledge of foundation conditions and without at least a preliminary design of the unusually high piers and long superstructure.

As shown in table 64, the 28-foot-wide bridge designed for a modified H30-S24 loading is being recommended for the Study 3 transportation system. This recommendation is based on two factors (1) that the heavier bridge design would allow its use by log trucks carrying up to 7500 board feet, which is the design capacity of the water handling facilities, and accordingly would allow timber-transportation cost savings to be made from the resultant allowable use of "off-highway" equipment over those road sections tributary to the bridge; and (2) of equal, or even greater, importance the H30-S24 design loading allows, whereas the H20-S16 loading does not, heavy fire fighting equipment such as D8, TD24, or HD 20 bulldozers weighing 45,000 to 55,000 pounds to be transported from one side to the other of the north end of the reservoir as needed without exceeding the designed capacity of the bridge. This capacity, which is fundamental to the Study 3 transportation system, is obtained at but a 10.4-percent increase in annual bridge cost, it being estimated that there is no increase in annual maintenance cost between the H30-S24 and the H20-S16 designs.

Section I, 13.8 miles long, extends from the east end of the proposed Webb Mountain bridge, along the east face of the reservoir to Pinkham Creek, up Pinkham Creek on a general 2-percent grade to an intersection with existing forest development road 856 in a saddle at elevation 3100, and thence down to Eureka at elevation 2571 along the location of existing low standard county roads on a general 2.5-percent grade. Because of anticipated local use of Section I from Eureka to the bridge and north along the west face of the reservoir, the estimate of annual public travel is 75,000 recreational

cars and 50,000 commercial vehicles. Section I serves the transportation of timber from west-side logging units 98 and 99 to Dump A for their summer-cut logs and from logging units 100, 101, and 102 to Eureka for reload onto rail for winter-cut logs. It also serves the transportation of timber from east-side logging units 103, 104, 105, and 106 to Dump A in summer and Eureka in winter. Despite the more favorable total annual road and transportation cost showing of a BB-24 construction standard for Section I, the BB-28 standard is recommended for the reasons given in the discussion of Section D, Route W.

Route W-N, 7.5 miles long, extends along the west face of the reservoir from the proposed Webb Mountain bridge to a connection with Yaak River-west side forest development road 92 at approximate elevation 2600 in Section 16, T36N, R28W. It is on the same location as corresponding sections of Route W of Studies 1 and 2. Route W-N serves particularly for the transportation of winter timber from logging units 100, 101, and 102 to Eureka. Public traffic is estimated at 10,000 recreational cars a year and 2500 commercial vehicles a year. Route W-N, the reservoir bridge, and Section I of Route W provide the access to Eureka for the families in the Tooley Lake area. The transportation costs of these types of traffic result in a showing that DD-16 construction standard provides the lowest total annual road and transportation costs.

Route S, Sections A and B, a total length of 2.9 miles, is on the same location, provides the same service, and is proposed for the same construction standard (BB-28) as Route S of Studies 1 and 2. A BB-28 standard was chosen in preference to a BB-24 standard despite the fact that the cost analysis favored the latter. The factors discussed in connection with Section D of Route W lead to this decision.

Route E, in Study 3, is on the location of the Highway 37 Route E of Studies 1 and 2 to Five Mile Creek, and from this point north to its terminus at the east end of the Webb Mountain bridge is on the location of Route E-N of Study 2. Because the heavy volume of public traffic is to be handled by State Highway 37 relocation over Route W of this study, the public traffic over Route E would be primarily local in character. Accordingly, Route E of Study 3 is mostly of lower construction standard than Route E highway relocation of Studies 1 and 2 to Five Mile Creek. However, the route provides exactly the same service to timber transportation as it did in Study 2.

Sections A and B, 9.9 and 9.6 miles long, respectively, are located as described in Studies 1 and 2. The estimated annual recreational traffic is 6000 cars, and commercial traffic 3500 vehicles. The timber volume to be transported and the administration and protection traffic to and from the proposed ranger station at Wolf Creek are the same as in Study 2.

The analysis shows that a DD-16 construction standard provides the lowest total annual road and transportation cost which, for combined Sections A and B, amounts to $125,181. The CC-20 construction standard shows no savings in timber-transportation costs since the difference in haul cost between a DD-16 and CC-20 road is negligible. However, for combined Sections A and B it is shown that an annual savings of $5,920 in timber-hauling costs could be made by adopting the BB-24 construction standard. The resultant increase of 17.3 percent in total annual road and transportation costs is considered justified not only because of the reduction in the hauling costs, but also because of the importance of Sections A and B as an administration and protection access from Libby to the proposed Wolf Creek Ranger Station. There is need for a two-lane road to safely handle the estimated public traffic of 9500 vehicles annually along with the timber-haul traffic. Therefore, the BB-24 construction standard is recommended.

Section C, as in Studies 1 and 2, is 12.5 miles long, and except for reduced public travel (2500 recreational cars and 1500 commercial vehicles annually) provides the same timber and administration and protection service as in Study 2. An EE-12 construction standard is indicated to provide the lowest total annual cost.

Notwithstanding, it is felt that with the number of trucks which would be operating on this road, a 12-foot standard would be inadequate from a safety standpoint. Therefore a DD-16 standard is recommended.

Section D, 7.6 miles long, as in Studies 1 and 2, is compared with the alternate high-line location, 12.1 miles long, which avoids the exceptionally difficult construction along the reservoir face between Dunn Creek and Canyon Creek. Despite the higher construction cost of the reservoir face alternate, it results in a lower total annual road and transportation cost for a DD-16 standard by $7991 annually, and is selected.

The DD-16 construction standard is recommended, as in preceding Section C, in place of the indicated lower cost EE-12 standard for reason of safety.

Section E, as in Studies 1 and 2, is 5.6 miles long between Cripple Horse Creek and Five Mile Creek. As in preceding Sections C and D, a DD-16 construction standard is recommended for reasons of safety although an EE-12 standard would result in the lowest total costs.

Sections F, G, and H are identical in length, location, and service to Sections A, B, and C of Route E-N of Study 2.

Section I, 3.6 miles long, extends from the terminus of Section H at Sutton Creek to a connection with Route W at the east end of the proposed Webb Mountain reservoir bridge. This section provides for the transportation of timber from logging unit 106 up the east face of the reservoir to Dump A at Pinkham Creek. The EE-12 construction standard is recommended because it would result in the lowest total road construction and transportation costs.

Table 66 summarizes the estimated road construction and annual costs for Study 3. It also summarizes the annual timber cut served by the planned road system.

Table 66. Summary of recommended Libby project transportation system restoration costs, except water facilities

Study 3

	Construction		Annual costs			Annual timber volumes served	
	Miles	Cost	Capital	Maintenance	Total	Sawlogs	Pulpwood
		- - - - - - - - - Dollars	- - - - - - - - - - -			Thousand bd.ft.	Cords
Roads							
State Highway 37 relocation	70.7	16,522,467	702,205	81,790	783,995	12,364	18,481
All other	88.45	6,194,799	263,279	41,275	304,554	19,880	29,231
Total	159.15	22,717,266	965,484	123,065	1,088,549	32,244	47,712
Trails							
T1, T2	30.0	66,000	2,805	600	3,405	-	-
Landing field	-	209,330	8,897	1,200	10,097	-	-

The deficiency of the Study 3 transportation system in providing access to logging units 86, 87, and 88, as well as to other units for which supplementary EE-12 roads financed by timber operations must be constructed, is the same as in Study 2. The total cost of the supplementary roads, $417,300, has been included in calculating wood-procurement costs under Study 3.

The significance of the vehicle miles of use in Study 3 by each of the traffic categories and their transportation costs, compared to the use and cost figures of Studies 1 and 2, is discussed in the following paragraphs.

Comparison of road cost analyses of Studies 1, 2, and 3

This summary discussion is limited to a comparison of the road costs between each study and a comparison of the services of the road systems as measured by the transportation costs incurred under each. A complete comparison of the cost effects of each transportation system, including the effects on timber production costs, employment stability, protection and administration, and communications is summarized in the body of this report.

The road and transportation costs for the three studies are summarized in table 67. The significance of the figures is explained, where necessary in the following paragraphs:

Table 67. Summary of road system analyses

Studies 1, 2, and 3

	Miles	Construction cost	Annual road cost: Capital	Annual road cost: Maintenance	Annual road cost: Total	Timber transportation: Annual volume served 1/	Timber transportation: Thousand bd.ft.-miles	Timber transportation: Annual transportation cost	Timber transportation: Cost per thousand bd.ft.	Mining transportation: Ton miles	Mining transportation: Annual transportation cost
		Dollars	Dollars	Dollars	Dollars	Thousand bd.ft.		Dollars	Dollars	Dollars	Dollars
Study 1											
State Highway 37 relocation	71.6	6,508,076	276,593	60,980	337,573	20,020	183,828	37,476	1.87	-	-
All other roads	134.55	8,102,414	344,352	33,512	377,864	12,298	217,102	40,673	3.31	972,800	91,444
Total	206.15	14,610,490	620,945	94,492	715,437	32,318	400,930	78,149	2.42	972,800	91,444
Study 2											
State Highway 37 relocation	71.6	7,107,323	302,061	62,580	364,641	23,672	274,478	48,382	2.04	-	-
All other roads	113.15	9,797,626	416,400	47,663	464,063	27,421	434,568	91,714	3.34	972,800	91,444
Total	184.75	16,904,949	718,461	110,243	828,704	51,093	709,046	140,096	2.74	972,800	91,444
Study 3											
State Highway 37 relocation	70.7	16,522,467	702,205	81,790	783,995	19,757	187,047	30,537	1.55	972,800	91,444
All other roads	88.45	6,194,799	263,279	41,275	304,554	31,572	396,159	81,615	2.59	-	-
Total	159.15	22,717,266	965,484	123,065	1,088,549	51,329	583,206	112,152	2.18	972,800	91,444

1/Including cordwood at the rate of 2.5 cords per 1000 board feet.

	Public travel: Recreational: Vehicle miles	Public travel: Recreational: Annual transportation cost	Public travel: Commercial: Vehicle miles	Public travel: Commercial: Annual transportation cost	Public travel: Total: Vehicle miles	Public travel: Total: Annual transportation cost	Administration and protection travel: Vehicle miles	Administration and protection travel: Annual transportation cost	Total annual transportation cost	Total annual road and transportation costs
		Dollars		Dollars		Dollars		Dollars	Dollars	Dollars
Study 1										
State Highway 37 relocation	3,791,250	394,290	2,224,250	342,535	6,015,500	736,825	102,155	15,731	790,032	1,127,605
All other roads	700,850	83,689	461,575	82,495	1,162,425	166,184	122,095	28,996	327,297	705,161
Total	4,492,100	477,979	2,685,825	425,030	7,177,925	903,009	224,250	44,727	1,117,329	1,832,766
Study 2										
State Highway 37 relocation	3,791,250	394,290	2,224,250	342,535	6,015,500	736,825	102,155	15,731	800,938	1,165,579
All other roads	682,205	78,144	457,022	79,298	1,139,227	157,442	119,882	26,209	366,809	830,872
Total	4,473,455	472,434	2,681,272	421,833	7,154,727	894,267	222,037	41,940	1,167,747	1,996,451
Study 3										
State Highway 37 relocation	5,040,280	524,189	3,673,580	565,732	8,713,860	1,089,921	104,850	16,147	1,228,049	2,012,044
All other roads	317,575	38,005	168,190	30,090	485,765	68,095	83,245	17,449	167,159	471,713
Total	5,357,855	562,194	3,841,770	595,822	9,199,625	1,158,016	188,095	33,596	1,395,208	2,483,757

Miles of construction, Study 1. Relying to a large extent on back-country roads and with State Highway 37 relocated on an indirect route, 18.2 miles of which are completely outside the Zone of Influence, requires a total of 206.15 miles of "project" road construction.

The lower mileage of Study 2 (184.75) shows the effect of relocating the back-country roads along the reservoir faces.

The lowest "project" road construction mileage of Study 3 (159.15) is obtained by locating State Highway 37 entirely on routes already required for timber access. This location eliminates all road construction outside the Zone of Influence except for about three miles adjacent to Eureka.

Total cost of construction. The estimated cost of the State Highway 37 relocation to a BB-24 construction standard in Study 1 averages $90,895 a mile, and "all other roads," due to the predominance of back-country mileage, $60,219 a mile.

In Study 2, although State Highway 37 is in the same location, its average per-mile cost increases to $99,264 because 32 miles of it, in serving a higher volume of timber transportation traffic, have been raised to a BB-28 construction standard. Likewise, the estimated cost of "all other roads," because they are predominantly located along the reservoir faces, increased to $86,590 a mile.

The State Highway 37 relocation of Study 3, located along the reservoir face for most of its length and including the reservoir bridge, has an average cost of $233,698 a mile. The estimated cost of "all other roads," which now include a lower standard route along one side of the reservoir face only, drops to $70,037 a mile.

Annual maintenance cost. The annual cost of capital is directly proportional to the construction cost already discussed. Accordingly, the annual cost of maintenance is the significant item to note here.

Only the highway maintenance costs are carried through the final cost summarizations of this report as such. Maintenance of "all other roads" is included in the wood-production costs of each study.

The estimated annual maintenance cost of all the BB-24 State Highway 37 location of Study 1 averages $852 a mile, which includes the effect of the two 4100-foot summits it crosses. The estimated annual maintenance cost of "all other" Study 1 roads, of which a considerable portion are for seasonal use only, is an average of $249 a mile.

In Study 2, the use of BB-28 construction standard for 32 miles increases the annual State Highway 37 maintenance cost to an average of $874 a mile. Since with the reservoir face location of "all other roads" they become all-year roads for the most part, the average maintenance cost of these roads increases to $421 a mile.

The average annual maintenance cost of the State Highway 37 location of Study 3, of which 43.3 miles are to a BB-28 construction and including the cost effect of one 3850-foot summit, is $865 a mile plus $21,000 for the bridge.

Mainline timber truck haul. The State Highway 37 location of Study 1 serves in transporting 20,020 thousand board feet of timber annually (sawlogs plus pulpwood at the conversion rate of 2.5 cords of pulpwood to one thousand board feet), principally from logging units of the mid-Fisher Group which are trucked to Libby cheaper than by either rail or water. The annual cost over the State Highway 37 location for the 183,828-thousand-board-foot miles of timber transportation is $37,476, or an average transportation cost against timber of $1.87 a thousand board feet. Correspondingly, the average annual cost against the 12,298 thousand board feet of timber transported on "all other roads" is $3.31 a thousand board feet, due to longer hauls over lower standard roads.

More timber, a total of 23,672 thousand board feet, is handled annually over the State Highway 37 relocation route of Study 2 since greater use of it is made in the transportation of winter-cut logs. Because of the longer truck haul involved, the average annual highway timber transportation cost increases to $2.04 a thousand board feet. A greater volume of timber is likewise handled on "all other roads" of Study 2 because they are relocated from generally high country to reservoir face routes. Since long hauls are involved in transporting the winter-cut timber to Libby, a total of 434,568-thousand-board-foot miles, the average annual timber transportation cost on "all other roads" is $3.34 a thousand board feet.

The State Highway 37 relocation route of Study 3 does not serve the transportation of timber from the Fisher River and accordingly the total annual volume served drops to 19,757 thousand board feet. The reservoir crossing provided by Study 3 highway route allows tributary timber to be trucked comparatively short distances (an average for the total length of highway of 187,047-thousand-board-foot miles/19,757-thousand-board-foot miles = 9.46 miles) to Eureka and to the east-side water dump at Pinkham Creek. Accordingly, the average annual highway transportation cost against timber drops to $1.55 a thousand board feet. The average annual timber transportation cost over "all other roads," which include a road on the route of the Studies 1 and 2 highway location to the mouth of Five Mile Creek, is $2.59 a thousand board feet. The advantage of the Study 3 road system to timber transportation is shown by the combined average annual timber transportation for all "project" roads of $2.18 a thousand board feet, compared to the $2.42 a thousand board feet of Study 1, and $2.74 a thousand board feet of Study 2.

Mining transportation. The road systems of Studies 1, 2, and 3 provide the same service. The only significance to be attached to this traffic item is that it does not use the State Highway 37 relocation of Studies 1 and 2; it does in Study 3. In this connection, gas and vehicle tax revenue would accrue to the State of Montana from the mine haul traffic over the highway relocation. However, the revenue from this source is small and has been neglected in any of the benefit calculations of this report.

Public travel on State Highway 37. No direct comparison can be made from table 67 of the services given to public traffic by the road systems of Studies 1, 2, and 3. Different traffic volumes and travel distances are involved. In order to evaluate the services to public traffic of three road systems, table 68 has been prepared.

In table 68 the annual public travel costs for Studies 0, 1, 2, and 3 are measured by the estimated volume of through public traffic and the travel distances incurred with the State Highway 37 route of Studies 1 and 2. To set up the greater through public traffic estimate of the highway route of Study 3 as a common factor for measurement would result in a fallacious determination of the public travel costs on the highway route of Studies 1 and 2.

The northern terminus of the highway route of Studies 1 and 2 is on US Highway 93 near Trego, approximately 14.9 miles southeast of Eureka. In computing the public travel costs between Libby and Eureka, it is estimated that one-half of the through recreational traffic and two-thirds of the through commercial traffic is destined for Eureka. The remaining recreational and commercial traffic, it is estimated, has no purpose in traveling to Eureka and would turn east on US Highway 93 when it leaves the State Highway 37 relocation route. This same assumption is carried through the determination of the public travel costs via the existing State Highway 37 route of Study 0, and via the proposed highway route of Study 3.

Consequently, the Study 0 costs, in addition to the through public travel costs on 63.4 miles of the existing route between Libby and Eureka, include the annual travel costs of one-half of 47,500 recreational cars and one-third of 27,500 commercial vehicles to a common point on US Highway 93, 14.9 miles southeast of Eureka. The resultant annual public travel costs via the existing State Highway 37 route of Study 0 are $639,533.

The highway route of Studies 1 and 2 begins on US Highway 2, four miles south of Libby. Accordingly, the total annual public travel costs of the Studies 1 and 2 route include the full through traffic over this four miles, plus the 71.6 miles of the "project" location, in addition to one-half of the through recreational and two-thirds of the through commercial traffic over the 14.9 miles of US Highway 93 to Eureka. The total annual public travel costs via the State Highway 37 relocation route of Studies 1 and 2 are $772,500, an increase of $132,967 annually over the costs of the Study 0 route.

The highway route of Study 3 begins on existing State Highway 37, 0.7 mile north of Libby. Including the full through traffic over this 0.7 mile, plus the 70.7 miles of the "project" location, plus one-half of the through recreational and one-third of the through commercial traffic over the 14.9 miles from Eureka to the common point on US Highway 93, the public travel costs are $712,933, an increase of $73,400 annually over the costs of the Study 0 route. As compared to the highway route of Studies 1 and 2, the highway route of Study 3 results in an annual savings of $59,567 in public travel costs.

Table 68. Comparison of public travel costs on State Highway 37

Studies 0, 1, 2, and 3

	Miles	Through vehicles per year	Vehicle miles	Cost per vehicle mile	Annual costs Study 0	Studies 1 and 2	Study 3
				- - - - - - Dollars	- - - - - -		
Study 0							
State Highway 37							
Recreational traffic	63.4	47,500	3,011,500	0.104	313,196		
Commercial traffic	63.4	27,500	1,743,500	0.154	268,499		
Eureka to end of project location of Studies 1 and 2							
Recreational traffic 1/2 (47,500)	14.9	23,750	353,875	0.104	36,803		
Commercial traffic 1/3 (27,500)	14.9	9,167	136,588	0.154	21,035		
Total	78.3		5,245,463		639,533		
Studies 1 and 2							
Project location							
Recreational traffic	71.6	47,500	3,401,000	0.104		353,704	
Commercial traffic	71.6	27,500	1,969,000	0.154		303,226	
Libby to beginning of project location							
Recreational traffic	4.0	47,500	190,000	0.104		19,760	
Commercial traffic	4.0	27,500	110,000	0.154		16,940	
End of project location to Eureka							
Recreational traffic 1/2 (47,500)	14.9	23,750	353,875	0.104		36,803	
Commercial traffic 2/3 (27,500)	14.9	18,333	273,162	0.154		42,067	
Total	90.5		6,297,037			772,500	
Study 3							
Project location							
Recreational traffic	70.7	47,500	3,358,250	0.104			349,258
Commercial traffic	70.7	27,500	1,944,250	0.154			299,414
Libby to beginning of project location							
Recreational traffic	0.7	47,500	33,250	0.104			3,458
Commercial traffic	0.7	27,500	19,250	0.154			2,965
Eureka to end of project location of Studies 1 and 2							
Recreational traffic 1/2 (47,500)	14.9	23,750	353,875	0.104			36,803
Commercial traffic 1/3 (27,500)	14.9	9,167	136,588	0.154			21,035
Total	86.3		5,845,463				712,933
Increase over Study 0 public travel costs					-	132,967	73,400

Highway maintenance costs vs. revenue. The comparison showing a savings in public travel costs for the State Highway 37 route of Study 3 is not complete without considering the effect of whatever part of its higher maintenance cost is defrayed by increased motor fuel tax revenue to the State of Montana. Table 69 summarizes the estimated motor fuel tax revenues under each study and compares it to the estimated highway maintenance costs of each. As opposed to the analysis of public travel costs where it was necessary to use identical traffic volumes and travel distances in each study, the revenue calculations can be based on the actual estimated traffic of each study.

In Study 0, no detailed transportation planning analysis has been made of the annual thousand-board-foot miles of timber transportation by truck that would develop if a dam were never built. Since it is reasonable to consider that so far as truck transportation of timber is concerned, the water transportation of Study 3 substitutes for the rail transportation of Study 0 and it is assumed for this purpose that truck transportation under Study 0 is the same as in Study 3. As shown in table 69, the motor fuel tax revenue from timber transportation is not large, and would not affect the final result appreciably even if the assumption were considerably in error. The vehicle miles of public and Forest Service traffic in Study 0 is a 50-percent increase of the 1951 annual 24-hour average traffic volume for existing State Highway 37 multiplied by its length of 63.4 miles. The estimated annual maintenance cost of $46,740 is taken from table 61. The annual revenue from motor fuel tax, $15,538, is deficient of the maintenance cost of the existing highway location by $31,202. Actually, there are other sources of revenue, such as vehicle use taxes, which would reduce this apparent deficiency. However, since these other sources are constant for each study, the motor fuel tax revenue is used alone to establish the relative maintenance cost deficiencies for the highway location of each study.

The thousand-board-foot miles of timber transportation and vehicle miles of public and Forest Service travel for Studies 1, 2, and 3 as given in table 69 are taken directly from the summarization of these items in table 67. The relative maintenance cost deficiency of the State Highway 37 route of Study 3, amounting to $9985 as compared to Study 1, and $8962 as compared to Study 2, must be included in a final comparison of the relative values of the alternate highway locations.

National forest administration and protection. The summary for Forest Service administration and protection travel in table 67 shows an annual cost of $44,727 incurred with the Study 1 road system, $41,940 with Study 2, and $33,596 with Study 3. Since the estimated volumes of this traffic are approximately the same in each case, the decreasing costs in favor of Study 3 are due to three factors:

1. Progressively lower travel distances to work areas from ranger station locations.

2. A more advantageous location of the higher standard roads where the volume of Forest Service business requires more travel.

Table 69. Maintenance costs vs. revenue on State Highway 37

Study	Timber haul: Thousand bd. ft.-miles	Timber haul: Total truck miles 1/	Timber haul: Fuel at 2.9 miles a gallon	Timber haul: Fuel tax revenue at 6¢ a gallon	Public and Forest Service travel: Vehicle miles	Public and Forest Service travel: Fuel tax revenue 2/	Total revenue	Estimated maintenance cost	Relative deficiency maintenance cost vs. revenue	Increase over Study 0 deficiency
			Gallons	Dollars		Dollars	Dollars	Dollars	Dollars	Dollars
0	187,047	57,552	19,846	1,191	3,586,855	14,347	15,538	46,740	31,202	-
1	183,828	56,562	19,504	1,170	6,117,655	24,471	25,641	60,980	35,339	4,137
2	274,478	84,454	29,122	1,747	6,117,655	24,471	26,218	62,580	36,362	5,160
3	187,047	57,552	19,846	1,191	8,818,710	35,275	36,466	81,790	45,324	14,122

1/ Total truck miles are obtained by dividing thousand-board-foot miles by 6.5 (assuming 6500 board feet a truck) and multiplying by 2 to convert loaded truck-miles to total roundtrip miles.

2/ The gas tax revenue of 0.4 cents a vehicle mile is based on the state gasoline tax of 6 cents a gallon, assuming an average consumption rate of 15 miles a gallon.

3. A shorter travel distance affecting the portion of the Forest Service traffic that travels through the supervisor's headquarters at Libby to Eureka.

Total annual road and transportation costs. The sum of the total annual road costs and total annual transportation costs progressively increases from Study 1 to Study 3. It is emphasized that no conclusion as to the relative merits of the three road systems can be made from these figures only. They are but one of the cost factors that enter into the evaluation of the total economic effect of the road system.

It has been shown that the Study 1 road system, costing $14,610,000, which does not provide for continuance of the existing economically vital yearlong logging operation is unsatisfactory for the transportation of timber products. It adds travel distances and time to the national forest fire suppression responsibility which alone might be responsible for major conflagrations threatening the value of the Kootenai River valley as a storage reservoir and endangering the timber resource which supports the economic life of Lincoln County. Likewise, it is deficient in providing fully satisfactory public travel service, either between Libby and Eureka or to families adjacent to the reservoir.

The Study 2 road system, costing $16,905,000, satisfies the yearlong logging requirement, but only at an increase in wood-procurement costs over present conditions with a consequent economic disadvantage to present and potential wood industries. As compared to the deficiencies of the Study 1 road system in discharging fire suppression responsibilities, the Study 2 system is a great improvement. However, it is still inadequate because of the lack of any means along the entire length of reservoir for the rapid transportation of men, equipment, and supplies from one side to the other. The Study 2 road system has the same deficiency with respect to public travel as in Study 1.

It has been shown in this transportation planning report and in the report on timber production costs that the Study 3 road system, costing $22,717,000, causes the least adverse impact to the timber industry. In fact, it is shown that for the Zone of Influence as a whole, the wood-procurement costs are actually reduced below those of Study 0. Primarily, this is due to the availability of a reservoir bridge crossing and to the presence of higher standard roads where they are most valuable for timber haul. The same bridge allows the important maneuverability of men, equipment, and supplies from one side of the reservoir to the other for fire fighting. It has also been shown that the Study 3 road system, with a reservoir bridge, causes the least disruption to the proven efficiency of the present national forest administrative plant. Likewise, by routing the State Highway 37 relocation via the west side of the reservoir across the bridge to Eureka, the best service to through and local public traffic is realized.

A fundamental advantage of the Study 3 road system, which has not been measured in dollars, is the flexibility it allows in timber operations. Study 3, rightly or wrongly, has assumed that the railroad spur from

Stryker to Eureka would be kept in service. Accordingly, all of the winter logging production from the north end of the reservoir, both west and east sides, is planned to be trucked to Eureka and reloaded onto rail for shipment to Libby. Should any factor not now foreseeable take the railroad spur out of service, the winter logging production from both east and west side areas could be trucked directly to Libby. Some increase in transportation cost would be incurred but the impact would be nowhere nearly as severe as if, without the highway haul, this timber were taken out of the available winter logging supply. Likewise, it is possible that future improvement in log haul trucks will actually make it more economical to truck timber to Libby from the Rexford area than to ship it by rail from Eureka. The availability of the bridge and west-side highway route would make it possible to take advantage of any such shift in the most economical transportation medium.

The strongest disadvantage of the Study 3 road system is in the increase in highway maintenance costs, not offset by increased motor fuel tax revenues, which has been shown to amount to $14,120 annually. This increase is due entirely to the maintenance burden of the reservoir bridge which is estimated at $21,000 annually.

Ferry service

A ferry is contemplated at the north end of the reservoir in Studies 1 and 2 to offset to a small extent the handicaps caused by the lack of a bridge in these plans. Such a ferry could only operate seasonally; it would be inadequate for log transportation, and it would be relatively slow. Nevertheless, it is to be preferred to nothing at all.

It is recommended that a barge type ferry 75 feet long and 28 feet wide be used. It should be large enough to carry one-half dozen cars, or a truck tractor and trailer with a D-8 bulldozer as cargo. Such a ferry could also carry an occasional load of logs if necessary.

Inasmuch as the ferry would be operated no more than six months a year, gas power would probably be more economical than diesel power because of lower initial cost. The ferry should be free running (that is not on a cable) with a sidepaddle wheel and a 50-horsepower motor. A sidepaddle ferry would be more suitable and cheaper than a pusher type. The ferry should carry ramps which could be raised or lowered. If it were to ply between the lower end of the present Pinkham Creek road on the east side of the reservoir and the Dodge Creek road on the other side, no new approaches would have to be built.

A ferry of the type described is estimated to cost $100,000 and provide service for 25 years. Following are the annual costs which would be involved in such service: investment at 2½ percent $5400; maintenance $3000; operating labor $3300; fuel, oil, etc. $1500; total $13,200.

Any changes in transportation routes and facilities as a result of the dam would affect the availability and value of the timber resources. Wood-procurement costs have been estimated in considerable detail for Studies 0, 1, 2, and 3, to measure the impact of each postdam plan upon the timber resource. The transportation plans of these studies have been explained in preceding pages. Briefly the purpose of each postdam study is this: Study 1, to rely as heavily as possible on water transportation; Study 2, to develop a low cost road system which would permit the movement of wood from the vicinity of the reservoir during the winter when extreme drawdown or ice eliminates the reservoir for wood transportation; Study 3, to develop a road system which would best serve all transportation needs and insure maximum flexibility of transportation by providing a bridge crossing near the present town of Rexford.

The cost analyses in this section of the appendix are based on the following assumptions (1) location of the dam at River Mile 204.9 with a maximum reservoir height of 2459 feet above sea level; (2) relocation of the railroad route from Libby along US Highway 2, down Fisher River, up Wolf Creek, and down Fortine Creek to a point near Stryker, there connecting with the present mainline; (3) all costs and values based on December 31, 1951 rates; (4) all of the timber within the Zone of Influence hauled to Libby for manufacture; (5) the private road tapping the Fisher River drainage would be available for hauling timber of all ownerships with no differential against timber not owned by the J. Neils Lumber Company, and (6) a pulpmill established in or near Libby.

Figures 45 and 46 show the probable means of transporting the timber from the various logging units with the present transportation system and with the systems proposed in Studies 1, 2, and 3.

Costs of seasonal logging in Study 1

The lumber industry in this area has a well-established practice of continuous logging except for four or five weeks in the spring when the frost is leaving the ground, forcing a suspension of hauling. By having the ponds full and scheduling some of the mill repairs during that period, no sawmill time is lost for shortage of logs. Unemployment of woods workers is held to a minimum by continuing log cutting and skidding during the breakup period wherever possible and switching some men over to road building and work in the sawmill yard.

There are many reasons why yearlong logging is desirable and important. Some may be measured in dollars; others are more or less intangible. Yearlong employment attracts a more desirable, stable, energetic class of woods worker than do the short-season, interruptable operations. Workers in Lincoln County forests are not transient. For the most part, they own their homes, maintain small farms or gardens, and are settled residents of the community. Consequently the labor turnover is low, thus minimizing the expense of recruitment, training,

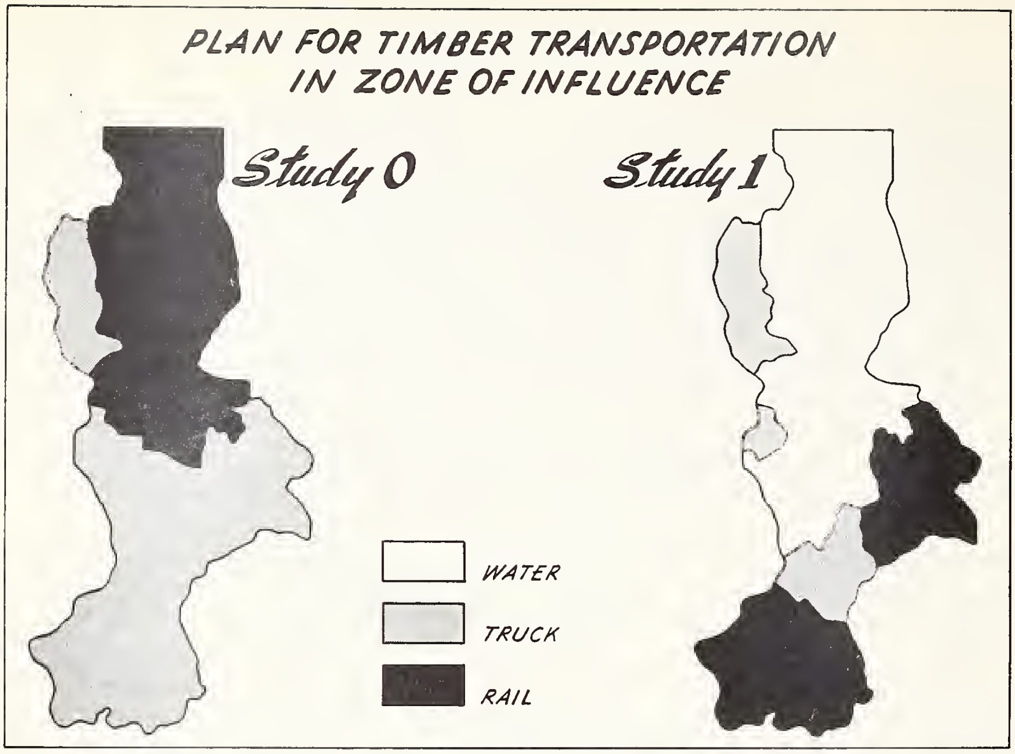

PLAN FOR TIMBER TRANSPORTATION
IN ZONE OF INFLUENCE
Study 0
Study 1
WATER
TRUCK
RAIL

Fig 45

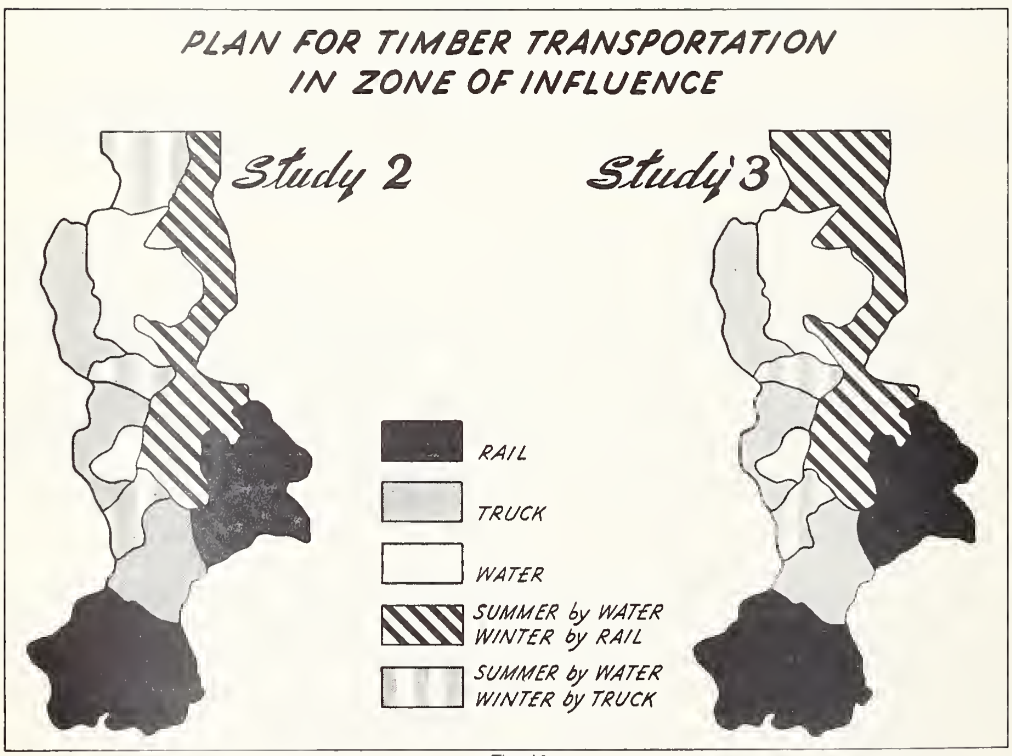

PLAN FOR TIMBER TRANSPORTATION
IN ZONE OF INFLUENCE
Study 2
Study 3
RAIL
TRUCK
WATER
SUMMER by WATER
WINTER by RAIL
SUMMER by WATER
WINTER by TRUCK

Fig. 46

and unemployment. The generally high efficiency of stably employed crews also tends to reduce logging costs. Wage schedules in seasonal camps, as well as gyppo contract rates, are ordinarily a little higher than prevail on yearlong operations. Other disadvantages of seasonal logging are:

1. It necessitates more storage of logs by reason of short logging season and inability to move logs in the winter. This ties up a larger working capital, increases interest charges, and involves extra handling of logs.

2. A larger investment in logging equipment is required. Annual interest, insurance, and depreciation charges on this equipment increase correspondingly.

3. Overhead and supervision costs increase.

Figure 45 shows that in Study 1 the reservoir would be the mainline of timber transport for the Kootenai River subzone and most of the timber from the Fisher River subzone would go to Libby by truck and rail. If other things were equal it would, therefore, be possible to operate on a yearlong basis by logging the water transport areas during the $6\frac{1}{2}$ months in which the reservoir is usable, then moving the crews to truck and rail haul areas for $4\frac{1}{2}$ months of the year (1 month shutdown during the spring breakup). Unfortunately for this arrangement, a disproportionate share of the winter logging area is in the locality which would be served by water transportation. There is a lack of winter logging areas elsewhere. Thus, dependence on water transportation to the degree contemplated in Study 1 would necessitate a shutdown of part of the operations during the 3 winter logging months. The principal upset in the logging program would occur in the Kootenai River subzone. A total of 27,851,000 board feet of annual cut of sawlogs, and 41,920 cords of other wood would be transported by water and thus be affected. The total annual allowable cut in the subzone is 32,944,000 board feet and 49,711 cords.

Data on page 37, "Cost of Hauling Logs by Motor Truck and Trailer," by Byrne, Nelson and Googins, indicate that total truck operating costs (interest, depreciation, taxes, insurance, and other) increase as the logging season is shortened. It appears these costs would increase by 10 percent at least, if the logging season were reduced from 11 to $6\frac{1}{2}$ months. If reduced from 11 to 8 months, the increase would probably be about 7 percent.[19] It seems safe to assume that other equipment costs would likewise rise at least 7 percent. Labor and overhead costs would undoubtedly rise more than that. A 7-percent increase across the board, therefore, appears entirely reasonable.

At the mill yard seasonal logging would result in a substantial additional cost for decking and undecking the logs. Considerable capital would be

19/ With an 8-month season, $6\frac{1}{2}$ months crew work would be within the Kootenai subzone, and $1\frac{1}{2}$ months employment could be arranged for elsewhere outside this subzone.

tied up in stored logs and there would be additional insurance to pay. For sawlogs the total increase in wood-procurement costs due to seasonal operation resulting from complete dependence on water transportation in the Kootenai subzone would be: logging $59,200, mill yard $18,100, total $77,300. Apportioned over the total annual cut of the Zone of Influence this amounts to $1.28 a thousand board feet. The average increase in cordwood-procurement costs due to seasonal operation would be 57 cents a cord based on the following total increases for the subzone: logging $36,100, mill yard $12,100, total $48,200.

Sawlog procurement costs

Tables 70 to 73, inclusive, itemize the cost of sawlog procurement from stump to mill with each plan of transportation. It will be noted that the total costs in Studies 1, 2, and 3 all exceed the $31.34 a thousand board feet of Study 0. The amount by which each exceeds Study 0 is shown below:

Study 1 + $3.57 a thousand board feet
Study 2 + .83 a thousand board feet
Study 3 + .61 a thousand board feet

Each cost estimate includes the construction of required main-haul roads over and above those which would be built as part of the restoration program by the agency building the dam. In Study 1, the timber itself would have to pay for building 41 miles of main-haul roads at a total cost of $1,385,000. These roads would be needed to give access to the planned log dumps and would serve the timber in logging units 82, 84, 85, 86, 89, 153, 154, 155, and 179. Only 15.62 miles of additional mainline road, costing $562,795, would be required for Studies 2 and 3. The road cost chargeable to timber in these two cases would be less than under Study 0. In computing the sawlog-procurement costs, the capital cost of these access roads is charged off against the present total volume of timber in the logging units which they serve.

Normally, the timber operation would be expected to pay the total cost of water facilities. However, the size of some of the facilities and their high cost make them a greater burden than the timber alone can bear. In fact, procurement costs in Study 1 are already so high as to make it infeasible to charge any of the water facilities to the timber in that case. All of the maintenance of these facilities and all of the operating costs would, however, be charged to the timber in each plan. The transportation section of this report indicates which facilities in each case should be built as part of the dam project and which should be paid for by the timber. Following is the total capital cost of water facilities and water-handling equipment charged to the timber in each study: Study 1, none; Study 2, $375,200; Study 3, $428,200.

The sawlog freight rates used in Study 0 were those actually in effect on December 31, 1951. Rates on the relocated portion of the railway in Studies 1, 2, and 3 were calculated. Mileages from various proposed landings to Libby were computed from map distances. These were multiplied by published per-mile rates on logs, adjusted to be more or less in line with existing point-to-point rates.

Table 70. Cost of sawlog production within Zone of Influence--stump to mill

Study 0

Item	Logging unit group: Libby	Warland	Stone-hill	Rex-ford	Libby-Big Creek	Average Kootenai River subzone
	Dollars per thousand board feet					
Roads and camps	2.05	1.62	3.33	1.50	1.07	1.86
Logging	21.38	22.23	23.31	20.92	22.63	22.00
Truck haul to water	-	-	-	-	-	-
Unload and bundle	-	-	-	-	-	-
Raft and tow	-	-	-	-	-	-
Lift and load	-	-	-	-	-	-
Truck haul dam to Libby	-	-	-	-	-	-
Maintenance water facilities	-	-	-	-	-	-
Truck haul stump to Libby	5.06	-	-	-	9.61	1.89
Truck haul to rail	-	3.25	2.59	3.72	-	2.42
Reload	-	1.60	1.60	1.60	-	1.19
Freight	-	2.90	3.30	3.70	-	2.44
Capital cost water facilities	-	-	-	-	-	-
Total	28.49	31.60	34.13	31.44	33.31	31.80

Item	Logging unit group: Lower Fisher	Mid-Fisher	Wolf Creek	Upper Fisher	Average Fisher River subzone	Average Zone of Influence[1]
	Dollars per thousand board feet					
Roads and camps	2.36	2.74	1.78	1.46	1.86	1.86
Logging	21.27	20.59	20.28	20.31	20.44	21.28
Truck haul to water	-	-	-	-	-	-
Unload and bundle	-	-	-	-	-	-
Raft and tow	-	-	-	-	-	-
Lift and load	-	-	-	-	-	-
Truck haul dam to Libby	-	-	-	-	-	-
Maintenance water facilities	-	-	-	-	-	-
Truck haul stump to Libby	5.30	8.07	9.41	8.62	8.50	4.90
Truck haul to rail	-	-	-	-	-	1.32
Reload	-	-	-	-	-	.65
Freight	-	-	-	-	-	1.33
Capital cost water facilities	-	-	-	-	-	-
Total	28.93	31.40	31.47	30.39	30.80	31.34

1/Based on annual cut of 60,474,000 board feet.

Table 71. Cost of sawlog production within Zone of Influence--stump to mill

Study 1

Item	Libby	Warland	Stone-hill	Rex-ford	Libby-Big Creek	Average Kootenai River subzone
	Logging unit group					
	Dollars per thousand board feet					
Roads and camps	7.52	4.63	3.78	2.02	1.08	3.70
Logging	21.39	22.79	22.44	21.92	22.61	22.39
Truck haul to water	2.30	3.17	3.71	4.37	-	3.07
Unload and bundle	.31	.39	.39	.39	-	.33
Raft and tow	.17	.50	.90	1.52	-	.69
Lift and load	.45	.57	.57	.57	-	.48
Truck haul dam to Libby	1.43	1.80	1.80	1.80	-	1.52
Maintenance water facilities	.56	.70	.70	.70	-	.59
Truck haul stump to Libby	.67	-	-	-	9.57	1.31
Subtotal	34.80	34.55	34.29	33.29	33.26	34.08
Capital cost water facilities1/	2.04	2.57	2.57	2.57	-	2.17
Total	36.84	37.12	36.86	35.86	33.26	36.25

Item	Lower Fisher	Mid-Fisher	Wolf Creek	Upper Fisher	Average Fisher River subzone	Average Zone of Influence
	Logging unit group					
	Dollars per thousand board feet					
Roads and camps	2.10	1.54	1.14	1.48	1.45	2.64
Logging	21.87	20.60	20.77	20.32	20.74	21.91
Truck haul to water	2.26	-	-	-	.22	1.56
Unload and bundle	.39	-	-	-	.04	.20
Raft and tow	.27	-	-	-	.03	.37
Lift and load	.57	-	-	-	.06	.29
Truck haul dam to Libby	1.80	-	-	-	.16	.91
Maintenance water facilities	.70	-	-	-	.07	.35
Truck haul stump to Libby	-	6.13	.82	-	1.24	1.28
Truck haul to rail	-	.64	2.61	3.45	2.29	1.04
Reload	-	.39	1.44	1.60	1.20	.55
Freight	-	.81	3.66	3.29	2.72	1.24
Subtotal	29.96	30.11	30.44	30.14	30.22	32.34
Capital cost water facilities1/	2.57	-	-	-	.25	1.29
Total	32.53	30.11	30.44	30.14	30.47	2/33.63

1/Cost against dam project. 2/Not including the added cost due to seasonal operation. For the entire Zone of Influence this amounts to $1.28 a thousand. $33.63 + $1.28 = $34.91.

Table 72. Cost of sawlog production within Zone of Influence--stump to mill

Study 2

Item	Libby	Warland	Stone-hill	Rex-ford	Libby-Big Creek	Average Kootenai River subzone
	Logging unit group					
	Dollars per thousand board feet					
Roads and camps	2.88	1.62	3.33	1.51	1.08	1.96
Logging	21.53	22.23	21.93	21.30	22.61	21.85
Truck haul to water	1.26	1.85	3.13	1.75	-	1.70
Unload and bundle	.30	.23	.39	.20	-	.23
Raft and tow	.19	.29	.93	.60	-	.43
Lift and load	.28	.32	.57	.29	-	.31
Truck haul dam to Libby	.90	1.01	1.80	.93	-	.98
Maintenance water facilities	.37	.42	.75	.39	-	.41
Truck haul stump to Libby	1.17	1.84	-	3.00	9.57	2.74
Truck haul to rail	.62	1.13	-	1.18	-	.76
Reload	.19	.32	-	.49	-	.25
Freight	.44	.74	-	1.65	-	.73
Capital cost water facilities1/	.82	.92	1.49	-	-	.69
Subtotal	30.95	32.92	34.32	33.29	33.26	33.04
Capital cost water facilities2/	.61	.69	1.08	1.46	-	.87
Total	31.56	33.61	35.40	34.75	33.26	33.91

Item	Lower Fisher	Mid-Fisher	Wolf Creek	Upper Fisher	Average Fisher River subzone	Average Zone of Influence
	Logging unit group					
	Dollars per thousand board feet					
Roads and camps	2.21	1.54	1.14	1.48	1.46	1.74
Logging	21.02	20.60	20.27	20.32	20.38	21.22
Truck haul to water	.96	-	-	-	.09	.97
Unload and bundle	.19	-	-	-	.02	.13
Raft and tow	.14	-	-	-	.01	.24
Lift and load	.28	-	-	-	.03	.18
Truck haul dam to Libby	.88	-	-	-	.08	.57
Maintenance water facilities	.37	-	-	-	.04	.24
Truck haul stump to Libby	3.79	6.13	.82	-	1.62	2.23
Truck haul to rail	-	.64	2.11	3.45	2.21	1.41
Reload	-	.39	1.44	1.60	1.20	.69
Freight	-	.81	3.66	3.29	2.72	1.64
Capital cost water facilities1/	.80	-	-	-	.06	.40
Subtotal	30.64	30.11	29.44	30.14	29.92	31.66
Capital cost water facilities2/	.61	-	-	-	.07	.51
Total	31.25	30.11	29.44	30.14	29.99	32.17

1/Cost against timber. 2/Cost against dam project.

Table 73. Cost of sawlog production within Zone of Influence--stump to mill

Study 3

Item	Libby	Warland	Stone-hill	Rex-ford	Libby-Big Creek	Average Kootenai River subzone
	Logging unit group					
	Dollars per thousand board feet					
Roads and camps	2.88	1.62	3.27	1.51	1.08	1.95
Logging	21.54	22.23	21.90	21.19	22.61	21.83
Truck haul to water	1.26	1.85	2.93	1.83	-	1.75
Unload and bundle	.30	.23	.39	.20	-	.23
Raft and tow	.19	.29	.93	.57	-	.42
Lift and load	.28	.32	.57	.29	-	.31
Truck haul dam to Libby	.90	1.01	1.80	.93	-	.98
Maintenance water facilities	.37	.42	.75	.39	-	.41
Truck haul stump to Libby	1.17	1.84	-	-	9.57	1.93
Truck haul to rail	.62	1.13	-	2.75	-	1.15
Reload	.19	.32	-	.78	-	.33
Freight	.44	.74	-	2.48	-	.95
Capital cost water facilities1/	.76	.87	1.50	.79	-	.84
Subtotal	30.90	32.87	34.04	33.71	33.26	33.08
Capital cost water facilities2/	.55	.62	1.10	.57	-	.60
Total	31.45	33.49	35.14	34.28	33.26	33.68

Item	Lower Fisher	Mid-Fisher	Wolf Creek	Upper Fisher	Average Fisher River subzone	Average Zone of Influence
	Logging unit group					
	Dollars per thousand board feet					
Roads and camps	2.21	1.54	1.14	1.48	1.42	1.67
Logging	21.02	20.60	20.27	20.32	20.47	21.20
Truck haul to water	.96	-	-	-	.09	1.01
Unload and bundle	.19	-	-	-	.02	.13
Raft and tow	.14	-	-	-	.01	.24
Lift and load	.28	-	-	-	.03	.18
Truck haul dam to Libby	.88	-	-	-	.08	.57
Maintenance water facilities	.37	-	-	-	.04	.24
Truck haul stump to Libby	3.79	6.13	.82	-	1.57	1.78
Truck haul to rail	-	.64	2.11	3.45	2.21	1.63
Reload	-	.39	1.44	1.60	1.20	.73
Freight	-	.81	3.66	3.29	2.72	1.75
Capital cost water facilities1/	.76	-	-	-	.07	.34
Subtotal	30.60	30.11	29.44	30.14	29.93	31.47
Capital cost water facilities2/	.54	-	-	-	.05	.48
Total	31.14	30.11	29.44	30.14	29.98	31.95

1/Cost against timber. 2/Cost against dam project.

Cordwood procurement costs

For the purpose of calculating procurement costs, the cordwood has been divided into two categories:

1. Thinnings, primarily trees thinned from young stands but also including harvest cuttings in lodgepole pine stands which, though mature, are undersawlog size. The allowable annual cut of this class of material is 45,401 cords.

2. Tops, cull, etc. This category includes sawtimber trees which are cull so far as lumber is concerned, undersawlog-size trees in sawtimber stands, and usable wood in tops of sawtimber trees. The allowable annual cut of this class of material is 38,932 cords.

The total allowable cut of cordwood in the Zone of Influence is 84,333 cords. Table 74 summarizes the cost of cordwood procurement from stump to mill. Two points are important in this table. First, there is not a great deal of difference between studies as to pulpwood-procurement costs. Second, the delivered cost of tops, cull, and understory trees is lower than for thinnings. This is because practically all of the tops, cull, and understory trees would be coming from logging areas where the roads and certain other costs would already be paid for by the sawtimber. However, it is estimated that the actual hauling cost for tops and cull would be 10 percent higher than the hauling cost for thinnings and understory trees because of a smaller wood content per cord due to knottier pieces.

Table 74. Cordwood-procurement costs, Zone of Influence

Study	Thinnings	Tops, cull, etc.	All cordwood
	Dollars per cord		
1/0	15.61	10.93	13.45
1	16.30	11.37	14.02
2	15.27	10.51	13.07
3	15.06	10.41	12.91

1/Including extra cost of seasonal operation.

Cordwood-procurement costs from thinnings in each of the four studies are itemized in tables 75-78, inclusive. Cordwood-procurement costs for tops, cull, and understory trees are itemized in tables 79-82, inclusive. These basic logging costs from stump to truck were taken directly from a report "Resource factors affecting the feasibility of pulpmills in eastern Montana," by S. Blair Hutchison and John H. Wikstrom.[20] These costs are realistic and just as appropriate here as in eastern Montana. Truck-hauling costs from woods to water dumps, railroad sidings, and direct to Libby were computed by applying the following per-cord-mile rates: spur roads within the logging units $0.17 per cord-mile, the better main or branch roads $0.108 per cord-mile, and highway $0.07 per cord-mile. To these computed totals was added $0.56 per cord for standby time.

20/Station paper 34, Northern Rocky Mountain Forest and Range Experiment Station, Missoula, Montana

The cost of transporting cordwood by water was estimated by making the following adjustments: cost per cord = sawlog rate per thousand board feet x .4 x 1.5. It has been assumed that such pulpwood as would be hauled by water would be put into the water for towing at the same points as the sawlogs from those units. The cordwood would be bundled in cord lots and handled by the same facilities as the sawlogs. The cordwood-procurement costs do not include any charge for the capital cost of water facilities. The timber share of these facilities is charged to sawlogs. They include an appropriate share of the cost of maintaining and operating these facilities.

Cordwood freight rates used were taken from table 15, page 27 of the Hutchison-Wikstrom report referred to above, with mileages from landings to Libby estimated from map measurements.

Table 75. Cost of cordwood production from thinnings within Zone of Influence--stump to mill

Study O

Item	Logging unit group: Libby	Warland	Stone-hill	Rex-ford	Libby-Big Creek	Average Kootenai River subzone
	Dollars per cord					
Roads and camps	1.97	1.51	2.14	1.91	1.50	1.77
Logging	8.70	8.70	8.70	8.70	8.70	8.70
Truck haul to water	-	-	-	-	-	-
Unload and bundle	-	-	-	-	-	-
Raft and tow	-	-	-	-	-	-
Lift and load	-	-	-	-	-	-
Truck haul dam to Libby	-	-	-	-	-	-
Maintenance water facilities	-	-	-	-	-	-
Truck haul stump to Libby	3.38	-	-	-	6.09	1.40
Truck haul to rail	-	2.41	2.43	2.45	-	1.61
Reload	-	.65	.65	.65	-	.48
Freight	-	2.00	2.27	2.42	-	1.60
Water facilities[1]	-	-	-	-	-	-
Total	14.05	15.27	16.19	16.13	16.29	15.56

Item	Logging unit group: Lower Fisher	Mid-Fisher	Wolf Creek	Upper Fisher	Average Fisher River subzone	Average Zone of Influence[2]
	Dollars per cord					
Roads and camps	1.20	1.18	1.22	1.56	1.37	1.62
Logging	8.70	8.70	8.70	8.70	8.70	8.70
Truck haul to water	-	-	-	-	-	-
Unload and bundle	-	-	-	-	-	-
Raft and tow	-	-	-	-	-	-
Lift and load	-	-	-	-	-	-
Truck haul dam to Libby	-	-	-	-	-	-
Maintenance water facilities	-	-	-	-	-	-
Truck haul stump to Libby	4.10	5.13	6.10	5.49	5.66	5.29
Truck haul to rail	-	-	-	-	-	-
Reload	-	-	-	-	-	-
Freight	-	-	-	-	-	-
Water facilities[1]	-	-	-	-	-	-
Total	14.00	15.01	16.02	15.75	15.73	15.61

1/No water facilities charged to cordwood.
2/Total annual production 45,401 cords.

Table 76. Cost of cordwood production from thinnings within Zone of Influence--stump to mill

Study 1

Item	Logging unit group: Libby	Warland	Stone-hill	Rex-ford	Libby-Big Creek	Average Kootenai River subzone
	Dollars per cord					
Roads and camps	1.97	1.93	2.14	5.25	1.50	1.97
Logging	8.70	8.70	8.70	8.70	8.70	8.70
Truck haul to water	1.93	2.71	2.26	2.90	-	2.24
Unload and bundle	.19	.24	.24	.29	-	.20
Raft and tow	.11	.30	.56	.74	-	.37
Lift and load	.28	.35	.35	.35	-	.30
Truck haul dam to Libby	.79	.99	.99	.99	-	.84
Maintenance water facilities	.22	.28	.28	.28	-	.23
Truck haul stump to Libby	.43	-	-	-	6.09	.81
Water facilities1/	-	-	-	-	-	-
Total	14.62	15.50	15.52	16.50	16.29	15.66

Item	Logging unit group: Lower Fisher	Mid-Fisher	Wolf Creek	Upper Fisher	Average Fisher River subzone	Average Zone of Influence
	Dollars per cord					
Roads and camps	1.60	1.52	2.08	1.40	1.70	1.87
Logging	8.70	8.70	8.70	8.70	8.70	8.70
Truck haul to water	2.18	-	-	-	.25	1.31
Unload and bundle	.24	-	-	-	.02	.14
Raft and tow	.16	-	-	-	.01	.24
Lift and load	.35	-	-	-	.03	.20
Truck haul dam to Libby	.99	-	-	-	.09	.67
Maintenance water facilities	.28	-	-	-	.02	.14
Truck haul stump to Libby	-	5.78	-	-	.87	.83
Truck haul to rail	-	-	2.49	2.65	1.85	.69
Reload	-	-	.65	.65	.50	.18
Freight	-	-	2.58	2.10	1.86	.76
Water facilities1/	-	-	-	-	-	-
Total	14.50	16.00	16.50	15.50	15.90	2/15.73

1/No water facilities charged to cordwood. 2/Not including the added cost due to seasonal operation. For the entire Zone of Influence this amounts to $0.57 a thousand. $15.73 + 0.57 = $16.30.

Table 77. Cost of cordwood production from thinnings within Zone of Influence--stump to mill

Study 2

Item	Logging unit group: Libby	Warland	Stone-hill	Rex-ford	Libby-Big Creek	Average Kootenai River subzone
	Dollars per cord					
Roads and camps	1.91	1.55	2.17	2.11	1.50	1.81
Logging	8.70	8.70	8.70	8.70	8.70	8.70
Truck haul to water	.80	.55	2.50	1.10	-	1.00
Unload and bundle	.12	.18	.27	.16	-	.12
Raft and tow	.05	.08	.11	.12	-	.09
Lift and load	.18	.21	.35	.20	-	.16
Truck haul dam to Libby	.48	.50	.95	.48	-	.59
Maintenance water facilities	.14	.18	.30	.14	-	.17
Truck haul stump to Libby	.95	1.57	-	.73	6.09	1.58
Truck haul to rail	.74	.73	-	1.78	-	.54
Reload	.10	.15	-	.30	-	.13
Freight	.31	.46	-	1.18	-	.43
Water facilities[1]	-	-	-	-	-	-
Total	14.48	14.86	15.35	17.00	16.29	15.32

Item	Logging unit group: Lower Fisher	Mid-Fisher	Wolf Creek	Upper Fisher	Average Fisher River subzone	Average Zone of Influence
	Dollars per cord					
Roads and camps	1.20	1.52	1.88	1.66	1.70	1.64
Logging	8.70	8.70	8.70	8.70	8.70	8.70
Truck haul to water	2.13	-	-	-	.18	.68
Unload and bundle	.18	-	-	-	.01	.08
Raft and tow	.10	-	-	-	.01	.05
Lift and load	.22	-	-	-	.02	.10
Truck haul dam to Libby	.72	-	-	-	.06	.44
Maintenance water facilities	.14	-	-	-	.01	.10
Truck haul stump to Libby	.70	5.20	-	4.64	2.65	1.95
Truck haul to rail	-	-	1.49	-	.52	.69
Reload	-	-	.60	-	.21	.16
Freight	-	-	3.25	-	1.13	.68
Water facilities[1]	-	-	-	-	-	-
Total	14.09	15.42	15.92	15.00	15.20	15.27

1/No water facilities charged to cordwood.

Table 78. Cost of cordwood production from thinnings within Zone of Influence--stump to mill

Study 3

Item	Logging unit group: Libby	Warland	Stone-hill	Rex-ford	Libby-Big Creek	Average Kootenai River subzone
	- - - - - - - - - - Dollars per cord					- - - - - - - -
Roads and camps	1.91	1.50	2.14	2.11	1.50	1.61
Logging	8.70	8.70	8.70	8.70	8.70	8.70
Truck haul to water	.80	.54	2.43	1.00	-	.96
Unload and bundle	.12	.18	.27	.16	-	.12
Raft and tow	.05	.08	.11	.12	-	.09
Lift and load	.18	.21	.35	.20	-	.16
Truck haul dam to Libby	.48	.50	.95	.48	-	.59
Maintenance water facilities	.14	.18	.30	.14	-	.17
Truck haul stump to Libby	.71	1.37	-	.23	6.09	1.38
Truck haul to rail	.50	.70	-	1.78	-	.66
Reload	.10	.15	-	.30	-	.13
Freight	.31	.46	-	1.18	-	.43
Water facilities[1]	-	-	-	-	-	-
Total	14.00	14.57	15.25	16.40	16.29	15.00

Item	Logging unit group: Lower Fisher	Mid-Fisher	Wolf Creek	Upper Fisher	Average Fisher River subzone	Average Zone of Influence
	- - - - - - - - - - Dollars per cord					- - - - - - - -
Roads and camps	1.20	1.52	1.88	1.66	1.70	1.63
Logging	8.70	8.70	8.70	8.70	8.70	8.70
Truck haul to water	2.13	-	-	-	.18	.67
Unload and bundle	.18	-	-	-	.01	.08
Raft and tow	.10	-	-	-	.01	.05
Lift and load	.22	-	-	-	.02	.10
Truck haul dam to Libby	.72	-	-	-	.06	.39
Maintenance water facilities	.14	-	-	-	.01	.10
Truck haul stump to Libby	.70	5.18	-	4.64	2.63	1.93
Truck haul to rail	-	-	1.49	-	.52	.57
Reload	-	-	.60	-	.21	.16
Freight	-	-	3.23	-	1.13	.68
Water facilities[1]	-	-	-	-	-	-
Total	14.09	15.40	15.90	15.00	15.18	15.06

1/No water facilities charged to cordwood.

Table 79. Cost of cordwood production from tops, cull, and understory trees within Zone of Influence--stump to mill

Study O

Item	Logging unit group: Libby	Warland	Stone-hill	Rex-ford	Libby-Big Creek	Average Kootenai River subzone
	Dollars per cord					
Roads and camps	.10	.10	.10	.10	.10	.10
Logging	5.05	5.05	5.05	5.05	5.05	5.05
Truck haul to water	-	-	-	-	-	-
Unload and bundle	-	-	-	-	-	-
Raft and tow	-	-	-	-	-	-
Lift and load	-	-	-	-	-	-
Truck haul dam to Libby	-	-	-	-	-	-
Maintenance water facilities	-	-	-	-	-	-
Truck haul stump to Libby	3.69	-	-	-	6.65	1.53
Truck haul to rail	-	2.65	2.66	2.69	-	1.76
Reload	-	.70	.70	.70	-	.52
Freight	-	2.18	2.49	2.66	-	1.74
Water facilities1/	-	-	-	-	-	-
Total	8.84	10.68	11.00	11.20	11.80	10.70

Item	Logging unit group: Lower Fisher	Mid-Fisher	Wolf Creek	Upper Fisher	Average Fisher River subzone	Average Zone of Influence2/
	Dollars per cord					
Roads and camps	.10	.10	.10	.10	.10	.10
Logging	5.05	5.05	5.05	5.05	5.05	5.05
Truck haul to water	-	-	-	-	-	-
Unload and bundle	-	-	-	-	-	-
Raft and tow	-	-	-	-	-	-
Lift and load	-	-	-	-	-	-
Truck haul dam to Libby	-	-	-	-	-	-
Maintenance water facilities	-	-	-	-	-	-
Truck haul stump to Libby	4.49	5.61	6.67	6.00	6.19	5.78
Truck haul to rail	-	-	-	-	-	-
Reload	-	-	-	-	-	-
Freight	-	-	-	-	-	-
Water facilities1/	-	-	-	-	-	-
Total	9.64	10.76	11.82	11.15	11.34	10.93

1/No water facilities charged to cordwood.
2/Total annual production 38,932 cords.

Table 80. Cost of cordwood production from tops, cull, and understory trees within Zone of Influence--stump to mill

Study 1

Item	Logging unit group: Libby	Warland	Stonehill	Rexford	Libby-Big Creek	Average Kootenai River subzone
	Dollars per cord					
Roads and camps	.10	.10	.10	.10	.10	.10
Logging	5.05	5.05	5.05	5.05	5.05	5.05
Truck haul to water	2.11	2.96	2.47	2.17	-	2.45
Unload and bundle	.21	.26	.26	.32	-	.22
Raft and tow	.12	.33	.61	.81	-	.40
Lift and load	.30	.38	.38	.38	-	.28
Truck haul dam to Libby	.86	1.09	1.08	1.09	-	.92
Maintenance water facilities	.22	.28	.28	.28	-	.23
Truck haul stump to Libby	.47	-	-	-	6.66	.88
Truck haul to rail	-	-	-	-	-	-
Reload	-	-	-	-	-	-
Freight	-	-	-	-	-	-
Water facilities 1/	-	-	-	-	-	-
Total	9.44	10.45	10.23	10.20	11.81	10.53

Item	Logging unit group: Lower Fisher	Mid-Fisher	Wolf Creek	Upper Fisher	Average Fisher River subzone	Average Zone of Influence
	Dollars per cord					
Roads and camps	.10	.10	.10	.10	.10	.10
Logging	5.05	5.05	5.05	5.05	5.05	5.05
Truck haul to water	2.38	-	-	-	.27	1.43
Unload and bundle	.26	-	-	-	.02	.15
Raft and tow	.17	-	-	-	.01	.26
Lift and load	.38	-	-	-	.03	.22
Truck haul dam to Libby	1.08	-	-	-	.10	.73
Maintenance water facilities	.28	-	-	-	.02	.14
Truck haul stump to Libby	-	6.32	-	-	.95	.94
Truck haul to rail	-	-	2.73	2.90	2.03	.75
Reload	-	-	.71	.71	.55	.20
Freight	-	-	2.82	2.30	2.03	.83
Water facilities 1/	-	-	-	-	-	-
Total	9.70	11.47	11.41	11.06	11.16	2/ 10.80

1/ No water facilities charged to cordwood. 2/ Not including the added cost due to seasonal operation. For the entire Zone of Influence this amounts to $0.57 per thousand. $10.80 + $0.57 = $11.37.

Table 81. Cost of cordwood production from tops, cull, and understory trees within Zone of Influence--stump to mill

Study 2

Item	Logging unit group: Libby	Warland	Stone-hill	Rex-ford	Libby-Big Creek	Average Kootenai River subzone
	Dollars per cord					
Roads and camps	.10	.10	.10	.10	.10	.10
Logging	5.05	5.05	5.05	5.05	5.05	5.05
Truck haul to water	.87	.60	2.73	1.20	-	1.26
Unload and bundle	.14	.20	.29	.17	-	.13
Raft and tow	.06	.09	.12	.13	-	.10
Lift and load	.20	.23	.38	.22	-	.18
Truck haul dam to Libby	.53	.54	1.04	.53	-	.65
Maintenance water facilities	.14	.18	.30	.14	-	.17
Truck haul stump to Libby	1.04	1.72	-	.80	6.66	1.72
Truck haul to rail	.81	.81	-	1.95	-	.59
Reload	.11	.16	-	.33	-	.14
Freight	.34	.50	-	1.29	-	.47
Water facilities[1/]	-	-	-	-	-	-
Total	9.39	10.18	10.01	11.91	11.81	10.56

Item	Logging unit group: Lower Fisher	Mid-Fisher	Wolf Creek	Upper Fisher	Average Fisher River subzone	Average Zone of Influence
	Dollars per cord					
Roads and camps	.10	.10	.10	.10	.10	.10
Logging	5.05	5.05	5.05	5.05	5.05	5.05
Truck haul to water	2.33	-	-	-	.20	.74
Unload and bundle	.20	-	-	-	.01	.09
Raft and tow	.11	-	-	-	.01	.05
Lift and load	.24	-	-	-	.03	.11
Truck haul dam to Libby	.79	-	-	-	.07	.48
Maintenance water facilities	.14	-	-	-	.01	.10
Truck haul stump to Libby	.76	5.68	-	5.07	2.90	2.13
Truck haul to rail	-	-	1.63	-	.57	.75
Reload	-	-	.65	-	.23	.17
Freight	-	-	3.55	-	1.24	.74
Water facilities[1/]	-	-	-	-	-	-
Total	9.72	10.83	10.98	10.22	10.42	10.51

1/No water facilities charged to cordwood.

Table 82. Cost of cordwood production from tops, cull, and understory trees within Zone of Influence--stump to mill

Study 3

Item	Logging unit group: Libby	Warland	Stone-hill	Rex-ford	Libby-Big Creek	Average Kootenai River subzone
	- - - - -	- - - - -	Dollars per cord	- - - - -	- - - - -	- - - - -
Roads and camps	.10	.10	.10	.10	.10	.10
Logging	5.05	5.05	5.05	5.05	5.05	5.05
Truck haul to water	.88	.59	2.66	1.09	-	1.05
Unload and bundle	.13	.20	.30	.17	-	.13
Raft and tow	.06	.09	.12	.13	-	.10
Lift and load	.20	.23	.38	.22	-	.18
Truck haul dam to Libby	.53	.54	1.04	.53	-	.65
Maintenance water facilities	.14	.18	.30	.14	-	.17
Truck haul stump to Libby	.16	.20	.32	.15	6.66	1.83
Truck haul to rail	.78	1.50	-	1.45	-	.65
Reload	.11	.16	-	.23	-	.12
Freight	.55	.77	-	.80	-	.39
Water facilities1/	-	-	-	-	-	-
Total	8.69	9.61	10.27	10.06	11.81	10.42

Item	Logging unit group: Lower Fisher	Mid-Fisher	Wolf Creek	Upper Fisher	Average Fisher River subzone	Average Zone of Influence
	- - - - -	- - - - -	Dollars per cord	- - - - -	- - - - -	- - - - -
Roads and camps	.10	.10	.10	.10	.10	.10
Logging	5.05	5.05	5.05	5.05	5.05	5.05
Truck haul to water	2.48	-	-	-	.20	.73
Unload and bundle	.20	-	-	-	.01	.09
Raft and tow	.11	-	-	-	.01	.05
Lift and load	.24	-	-	-	.03	.11
Truck haul dam to Libby	.79	-	-	-	.06	.43
Maintenance water facilities	.14	-	-	-	.01	.10
Truck haul stump to Libby	.77	5.66	-	5.07	2.88	2.12
Truck haul to rail	-	-	1.69	-	.57	.72
Reload	-	-	.66	-	.23	.17
Freight	-	-	3.54	-	1.24	.74
Water facilities1/	-	-	-	-	-	-
Total	9.88	10.81	11.04	10.22	10.39	10.41

1/No water facilities charged to cordwood.

The Zone of Influence includes 569,193 acres of national forest. This is 70 percent of the total land area in the zone. It is not surprising, therefore, that construction of a dam at Mile 204.9 would have some major effects on national forest administration. The Warland and Rexford Ranger Stations and many miles of communication line would be inundated. The administration, fire protection, and range, wildlife, and recreational management jobs on the national forest would be affected. This appendix presents basic material relating to each of these problems.

Replacement of ranger stations

Table 83 contains an estimate of the cost of replacing the facilities located at the headquarters of the Warland Ranger District. These facilities include the station itself and a work center located at the station. Under the restoration plans, the headquarters and work center would be at different locations. The total cost is estimated to be $147,736. Figure 47 consists of photographs of two buildings at the present Warland Ranger District headquarters. Figure 48 is a plan of the ranger station layout and water system. Figure 49 is a series of detailed sketches of the buildings and structures at this station. Table 84 itemizes miscellaneous improvements at the Warland Station.

Table 85 itemizes the replacement values of the facilities at the headquarters of the Rexford Ranger Station, including the headquarters itself and a work center at the same location. Under the restoration plans the two would be separated. The total replacement value is $126,958. The Rexford facilities presently receive electricity from a commercial line. However, the work center as located in Studies 1 and 2 would have to generate its own power. A power plant, therefore, is included in the facilities listed in table 85. Figure 50 shows photographs of two of the principal buildings at the Rexford Ranger Station. Figure 51 is a layout of the station. Figure 52 is a series of detailed sketches of the buildings and structures at this station.

Studies 1 and 2 call for the establishment of a new ranger district to offset the limitations of the transportation systems. Table 86 lists the facilities which would be required for the new station and the cost of each. These costs which total $128,000 are approximate, as no site or building plans have yet been prepared. Establishment of a new ranger station would increase the annual cost of maintaining these facilities. This cost has not been estimated.

In Studies 1 and 2, the headquarters of the Warland Ranger District would be moved to Wolf Creek and the work center to Warland Creek. The Rexford District headquarters would be located at Eureka. A work center would no longer be required for this district, so the existing work center would be relocated at Big Creek on the new ranger district which would have its headquarters at Bristow Creek. Both of the latter are on the west side of the reservoir.

Table 83. Replacement value of Warland Ranger Station

Item	Number	Linear feet	Square feet	Cost to replace
				Dollars
Ranger district headquarters				
Dwelling, ranger, 28' x 28'	1			
1st floor			784	9,780
2nd floor			784	5,880
Office-warehouse, 30' x 40'	1			
1st floor			1,200	12,000
2nd floor			1,200	6,000
Dwelling, assistant ranger	1		863	8,630
Woodshed-storage, assistant ranger	1		308	1,540
Dwelling, headquarters guard	1		631	5,048
Truck and equipment storage	1		960	9,600
Generator sheds	2		150	150
Woodshed, ranger	1		180	900
Grease rack-oil house, gas pump tank	1		64	600
Replace 550-gallon tank				150
Garage, ranger	1		308	1,200
Barn and hay shed	1		720	2,160
Saddle shed	1		72	72
Water supply dam	1	48		2,400
Fence, corral, 6-pole, 8" post, 6' high	1	295		885
Gate, pole, 12'	2	24		48
Feed rack	1			90
Fence, 4-pole, 8" post, 12' spacing	1	372		930
Fence, 3-pole, 7" post, 12' spacing	1	2,676		5,552
Fence, 2-wire, 1-pole, 6" posts, 12' spacing	1	330		330
Fence, 2-wire, 2-pole, 6" posts, 12' spacing	1	784		982
Fence, 3-wire, 6" posts, 16' spacing	1	290		145
Fence, wire net, 6' high, top rail, 6" post	1	320		640
Gate, pole, swinging	2	28		140
Cattle guard	2			300
Driveway		550		1,100
Distribution system, electrical, poles	1			515
Distribution system, phone, 6-pole	1			435
Distribution system, water		3,650		4,697
Distribution system, sewage	1			2,228
2 cesspools and 2 septic tanks				
Pole, flag	1			25
Lawn	3		25,685	2,569
Shrubbery	42			810
Walk, flagstone	1	45		45
Weather station	1			310
Pasture, 20 acres	1			500
Sign, entrance, informational	2			150
Subtotal				89,536
Add for clearing, landscaping, driveways, new site				13,000
Architectural work, engineering, overhead (10 percent)				10,253
Total ranger district headquarters				112,789

Table 83. Replacement value of Warland Ranger Station (Cont.)

Item	Number	Linear feet	Square feet	Cost to replace
				Dollars
Work center				
Kitchen-messhall	1		1,100	6,000
Bunkhouse	2		2,200	8,800
Storage, gas and oil	1		144	350
Storage, meat and vegetable	1		72	280
Latrine (no replacement necessary)	1		234	
Garage-shop	1		516	1,000
Bathhouse-washroom	1		360	1,340
Distribution system, water	1			4,000
Distribution system, sewage	1			3,000
Subtotal				24,770
Add for clearing, landscaping, driveways, new site				7,000
Architectural work, engineering, overhead (10 percent)				3,177
Total work center				34,947
Total Warland Ranger Station				147,736

Table 84. Other miscellaneous improvements, Warland Ranger Station

Item	Number	Linear feet
Fences, gates, and cattle guards		
Fence, corral, 6-pole, 8" round posts, 10' spacing, 6' high	1	295
Gate, 12'	2	
Feed rack	1	
Fence, 4-pole, 8" round posts, 12' spacing		372
Fence, 3-pole, 7" round posts, 12' spacing		2,676
Fence, 2-wire, top pole, 6" posts, 12' spacing		330
Fence, 2-wire, 2-pole, 6" posts, 12' spacing		784
Fence, 3-wire, 6" posts, 16' spacing		290
Fence, wire net, 6' high, top rail, 6" posts, 12' spacing		320
Gate, pole, swinging, 14'	2	
Guard, cattle, 15' steel rail, 56 pounds, 18 piece, on 4 wood stringers	2	
Driveway and roads		
10' to 12' wide, gravel surface		550
10' to 12' wide, no surface		90
Signs		
Entrance, hanging type, on 14" post, 12' long, 3½"	1	
Fire prevention, hanging type, 2-post	1	
Electricity distribution lines		
Cedar pole, 30' butt treated	6	
Crossarm, 4-pin	13	
Anchor and guy wire	3	
Main wire		2,280
Lead-in wire		700
Phone line lead-in		
Cedar pole, 25', butt treated	6	
Crossarm, 10-pin	15	
Wire, 10 neoprene twisted pair		2,000
Water supply pipe		
Galvanized steel pipe, 4" diameter		100
Galvanized steel pipe, 2" diameter		1,050
Galvanized steel pipe, 1½" diameter		625
Galvanized steel pipe, 1¼" diameter		200
Galvanized steel pipe, 1" diameter		350
Galvanized steel pipe, 3/4" diameter		1,325
Water supply dam	1	
Sewer pipe		
Soil pipe, 4"		175
Tile pipe, 4"		275
Septic tank	2	
Cesspool	2	
Flag pole, 30'	1	

Table 84. Other miscellaneous improvements, Warland Ranger Station (Cont.)

Item			Number	Linear feet
Lawns, total of 25,685 square feet			3	
Weather station			1	
Pole, 25', for wind gauge	1	) painted		
Fence, 3' wire, 8" mesh	100 feet	)		
Posts, 6" round	10 feet	)		
Top rail	100 feet	)		

Table 85. Replacement value of Rexford Ranger Station

Item	Number	Linear feet	Square feet	Cost to replace
				Dollars
Ranger district headquarters				
Dwelling, ranger	1		1,116	16,740
Office, ranger	1		672	6,720
Dwelling, assistant ranger	1		675	6,750
Dwelling, timber-sale officer	1		480	4,800
Equipment storage-warehouse	1		960	5,760
Garage, ranger	1		448	896
Barn and shop	1		928	5,566
Oil and gas house	1		320	1,600
Bunkhouse	1		364	2,548
Corral, catch chute, with trough and loading dock	1			465
Rack, grease, pole and plank	1			200
Fence, ranger dwelling, 8" posts, 12' spacing, 2-bar 2x4's, painted		482		482
Fence, property, 8" posts, 10' spacing		825		412
Distribution system, electrical, wire	5			421
Distribution system, water		1,349		2,311
Distribution system, sewage	1	696		3,336
3 cesspools and 3 septic tanks				
Pole, flag, 50', and antenna	3			90
Lawn, ranger residence			14,000	1,400
Lawn, trailer residence			1,500	150
Shrubbery	16			300
Walk, concrete			420	210
Parking court			1,600	48
Rail, 8" posts, 8"-pole		230		69
Fireplace-grill, ranger residence	1			250
Pump, gasoline	1			50
Tank, 500-gallon, underground	1			135
Sign	32			413
Weather station, fence and pole	1			310
Subtotal				62,432
Add for clearing, landscaping, driveways, new site				15,000
Architectural work, engineering, overhead (10 percent)				7,743
Total ranger district headquarters				85,175
Work center				
Cook and messhall	1		1,000	8,000
Bunkhouse	1		1,000	7,500
Laundry and bathhouse	1		520	6,500
Light plant	1			3,500
Distribution system, water	1			4,000
Distribution system, sewage	1			3,000
Gasoline and oil dispensary pump, tank, oil house	1			485
Subtotal				32,985
Add for clearing, landscaping, driveways, new site				5,000
Architectural work, engineering, overhead (10 percent)				3,798
Total work center				41,783
Total Rexford Ranger Station				126,958

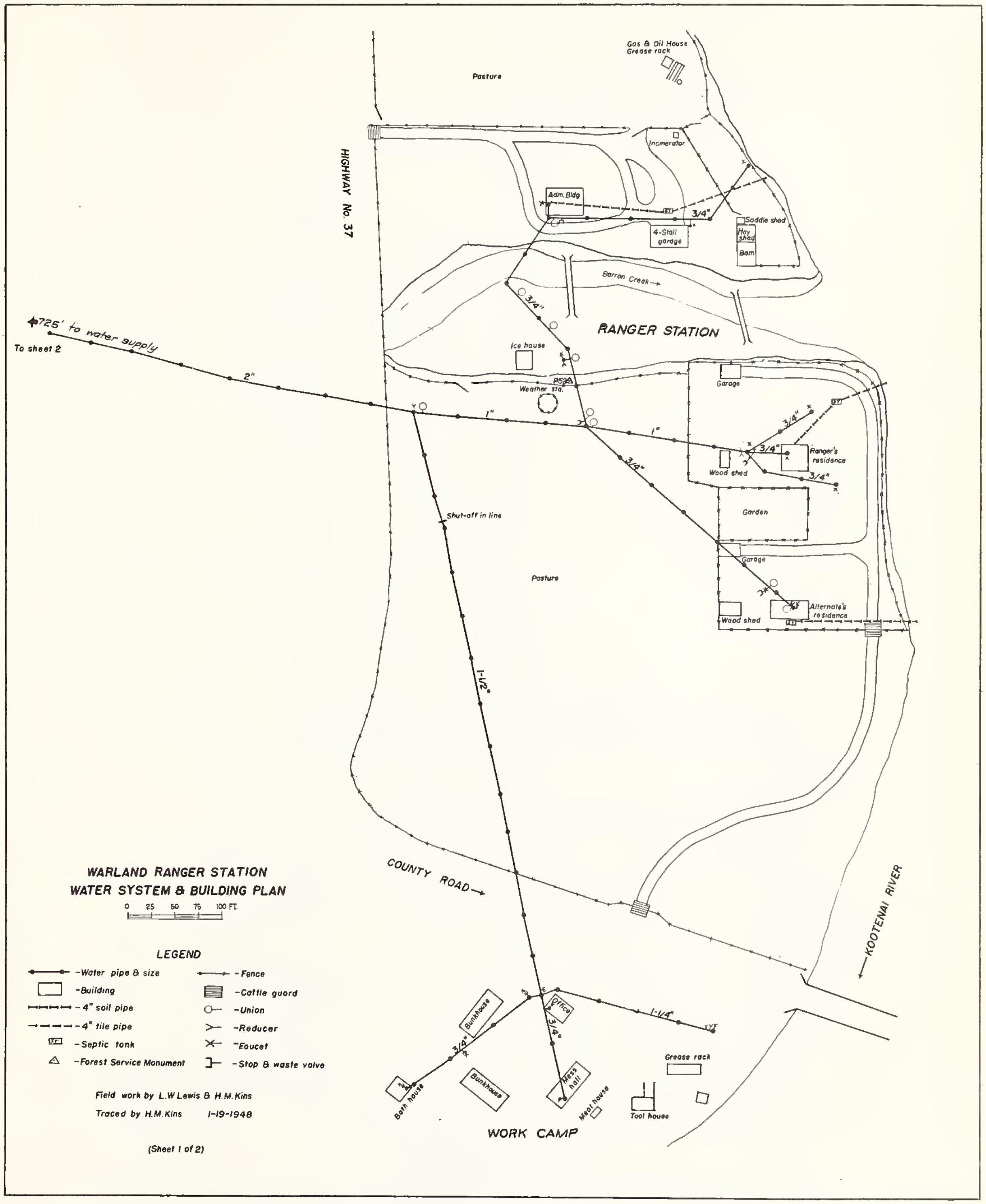
Table 86. Required improvements and estimated construction cost of an additional ranger station

Item	Number	Linear feet	Square feet	Cost to replace
				Dollars
Ranger district headquarters				
Dwelling, 6-room, 30' x 40'	1		1,200	15,000
Dwelling, 5-room, 26' x 38'	1		988	13,500
Office, 3-room, 18' x 26'	1		468	7,500
Warehouse, 24' x 40'	1		960	8,160
Truck and equipment storage	1		1,200	9,600
Shed, wood and tool, 14' x 16'	2		448	2,016
Grease rack-oil house, gas tank and pump	1			1,500
Garage, 12' x 22'	2		528	2,640
Barn, 20' x 30'	1		600	3,600
Shop, 16' x 16'	1		256	1,280
Kitchen-messhall, 20' x 50'	1		1,000	7,000
Bunkhouse, 20' x 50'	1		1,000	7,000
Laundry-bathhouse, 20' x 30'	1		600	8,000
Corral and feed rack	1	300		1,200
Fence, 6" posts, 12' spacing, 4-wire	1	3,000		3,000
Driveway	3	600		1,200
Distribution system, phone, 8-pole	1	500		310
Distribution system, water	1	3,600		4,500
Distribution system, sewage	1	750		3,750
5 cesspools and 5 septic tanks				
Pole, flag	1			25
Lawn	3	25,000		2,500
Shrubbery	30			500
Sidewalk	4	200	800	320
Weather station	1			350
Sign, entrance, informational	2			150
Light plant	1			3,500
Subtotal				108,101
Add for clearing, landscaping, driveways, new site				5,000
Architectural work, engineering, overhead (10 percent)				14,940
Total ranger district headquarters				128,041
Work center				none

Ranger dwelling

Warehouse-office

Figure 47. Two buildings at Warland Ranger Station headquarters.



WARLAND RANGER STATION
WATER SYSTEM & BUILDING PLAN
0 25 50 75 100 FT.
LEGEND
-Water pipe & size
-Building
-4" soil pipe
-4" tile pipe
-Septic tank
-Forest Service Monument
-Fence
-Cattle guard
-Union
-Reducer
-Faucet
-Stop & waste valve
Field work by L.W Lewis & H.M.Kins
Traced by H.M.Kins 1-19-1948
(Sheet 1 of 2)
Gas & Oil House
Grease rack
Pasture
HIGHWAY No. 37
Incinerator
Adm. Bldg
4-Stall garage
Saddle shed
Hay shed
Barn
Barron Creek
RANGER STATION
725' to water supply
To sheet 2
Ice house
Weather sta.
Garage
Ranger's residence
Wood shed
Garden
Garage
Alternate's residence
Wood shed
Shut-off in line
Pasture
COUNTY ROAD
KOOTENAI RIVER
Bunkhouse
Office
Bath house
Bunkhouse
Mess hall
Meat house
Grease rack
Tool house
WORK CAMP

Fig. 48 - Part 1

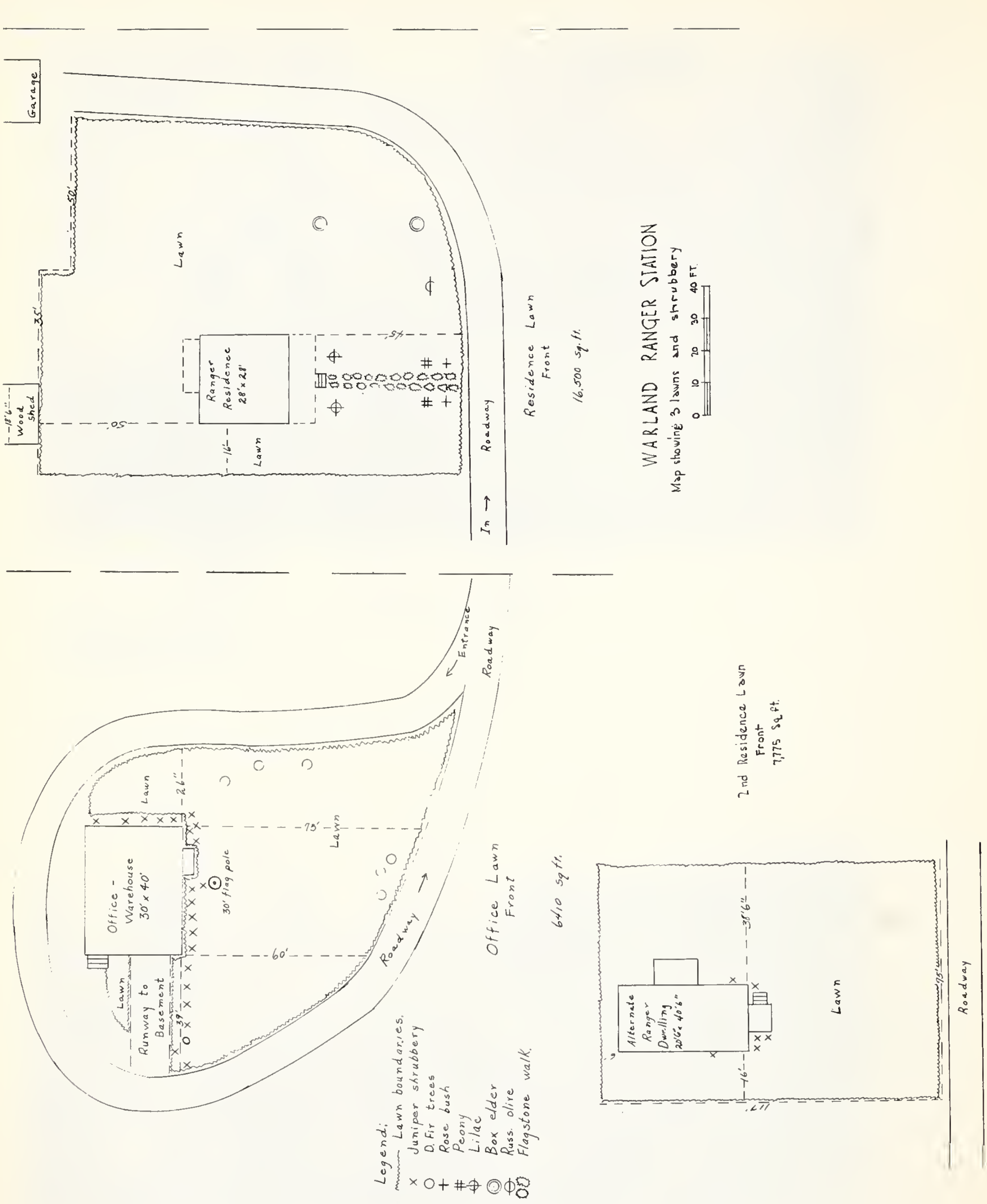

WARLAND RANGER STATION
Map showing 3 lawns and shrubbery
0 10 20 30 40 FT.
Garage
Wood shed
18'6"
50'
35'
Lawn
Ranger Residence 28'x28'
54'
50'
16'
Roadway
In →
Residence Lawn Front
16,500 sq.ft.
Entrance
Roadway
Office - Warehouse 30' x 40'
30' flag pole
73'
60'
26"
39'
Runway to Basement
Office Lawn Front
6410 sq ft.
2nd Residence Lawn Front
7,775 sq.ft.
Alternate Ranger Dwelling 20'6" x 40'6"
37'6"
16'
77'
Legend:
Lawn boundaries.
Juniper shrubbery
D. Fir trees
Rose bush
Peony
Lilac
Box elder
Russ. olive
Flagstone walk.

Fig. 48 - Part 2

WARLAND RANGER STATION

Ranger Dwelling

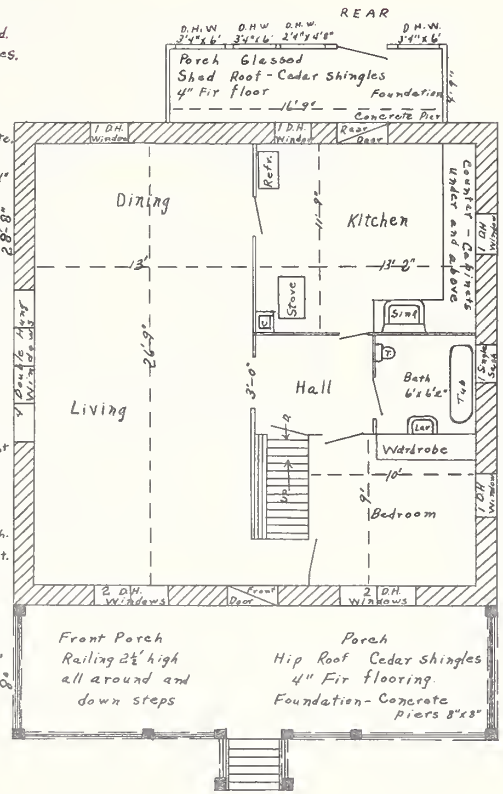
Const: Log walls stripped and sided on outside and stripped with wallboard on inside walls. Outside walls thus about 16" in total thickness.

Outside Detail:
4" Lap Siding, painted.
Roof, 1/3 P. Cedar shingles.
Foundation, concrete wall all around.
Storm & screen windows & doors complete.
Insulated Ceiling.
Brick chimney 16"x24"
Fir floors covered with linoleum in all rooms, first floor.
Porches as shown.
Wired 13 L. Drops, 7 switches, 11 outlets.
Inside walls & ceilings of 4'x8' hard board.
Part basement of concrete 13'4" x 11'6" inside measure.

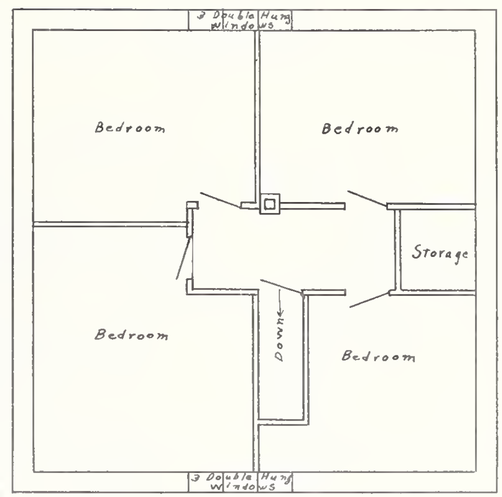
Windows & Doors:
2 ea. D.W.-D.H. 2'1"x2'3" Sash 4 Light
2 ea. Triple D.H. " x " " "
1 ea. Quad D.H. " x " " "
6 ea. S.W. D.H. " x " " "
1 ea. Single sash 20"x24" Bath.
1 ea. " " 17"x34" Basem't.
6 ea. " " 3'x3'4" R. porch
2 ea. " " 2'x2' " "
2 ea. Doors 2'10" x 6'10"
1 ea. " 2'10" x 6'8"
10 ea. Light panel Doors 2'8"x6'8"

Plumbed for the Kitchen sink.
Water heater tank.
Bath Tub.
Lavatory.
Toilet.
Plumbed in drains to cesspool.

FIRST FLOOR



SECOND FLOOR

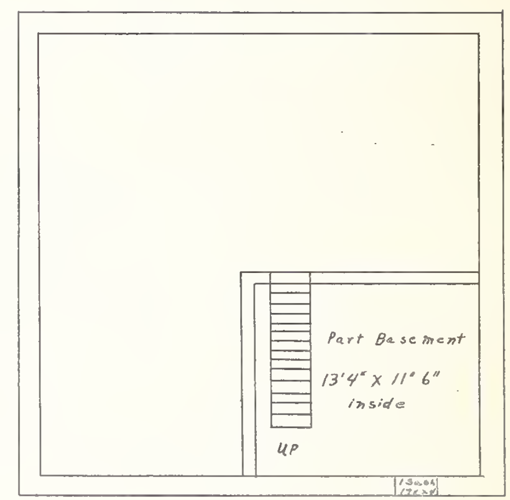


Upper Floor finished wall board walls & ceiling
Floors Fir, or Larch 4" T. & G.
Windows & Doors included in List

FRONT

0 5 10 FT.

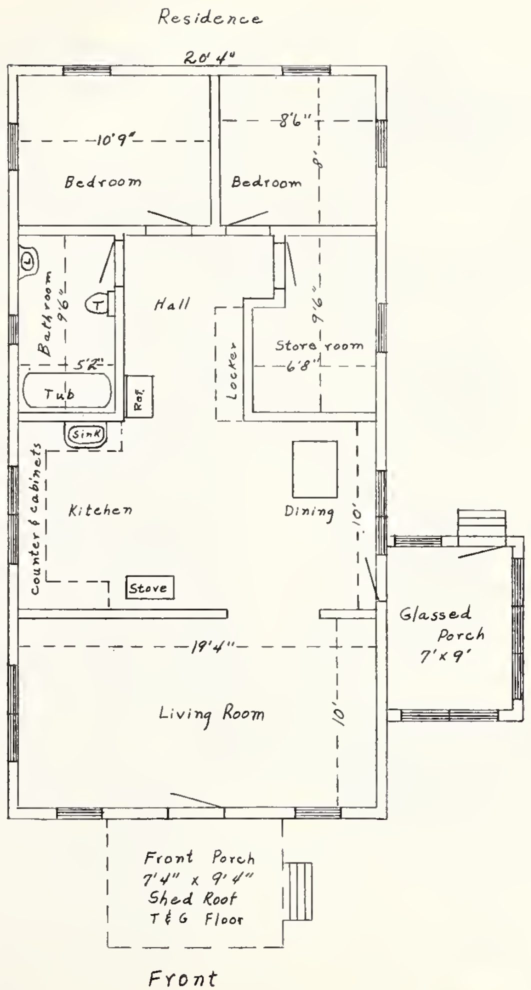
FOUNDATION &
PART BASEMENT



FRONT

C.S.W.
8-28-52

Fig 49 - Part 1



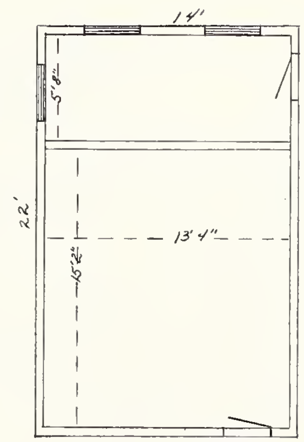
Outside:
Walls - 6" Rustic Siding - painted.
Roof - 1/3 pitch, cedar shingles.
Chimney - Brick - 16" x 16".
Sills - Treated; on blocks.
Doors - 3 outside, Fir p.
4 inside, Fir p.

Windows:
9 single 2'4" x 3' sash, 9 light.
2 double sliding - 2 sash ea.
2'4" x 3' sash, 9 light.
Porch: 6 D.H. windows each
2 sash 2'6" x 2'8", 2 light.

Kitchen & Bath plumbed to
drain to septic tank.
Wired: 8 light drops
5 outlets
7 switches.

Inside: walls & ceiling
of 10" shiplap.
Floors - T. & G. Fir.
Linoleum covers kitchen,
hall, & bath.

C.S.W.
9-1-52



Woodshed

Outside:
6" Rustic siding
painted white
Roof - 1/3 pitch, cedar shingles
Windows:
3 ea 2'4" x 3' - 6 light
2 ea 2'4" x 2'6" - 6 light
2 doors 3' x 6' 8"
Inside:
Unfinished bare studs
2' center.
Plank floor
Wood block foundation.

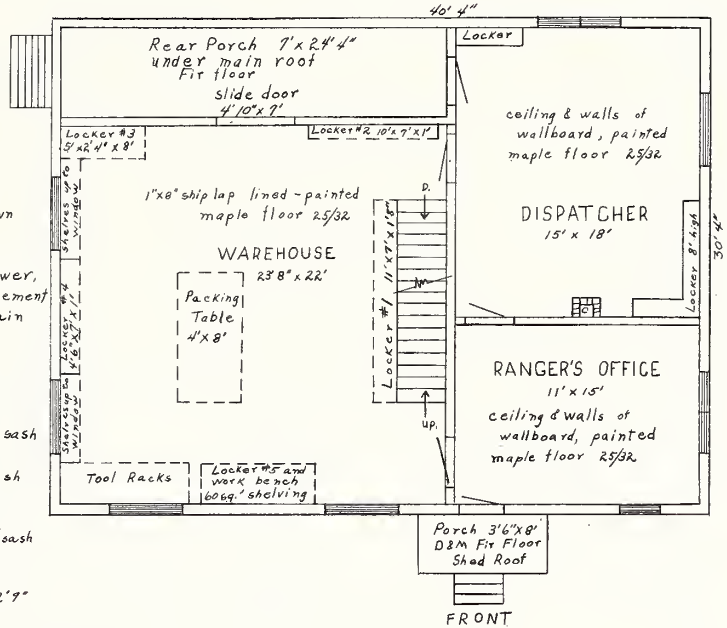
WARLAND RANGER STATION

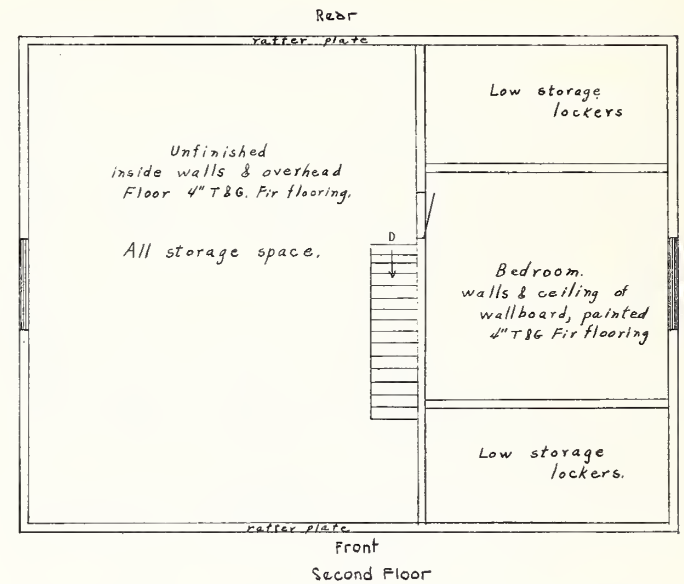
Assistant Ranger's Residence

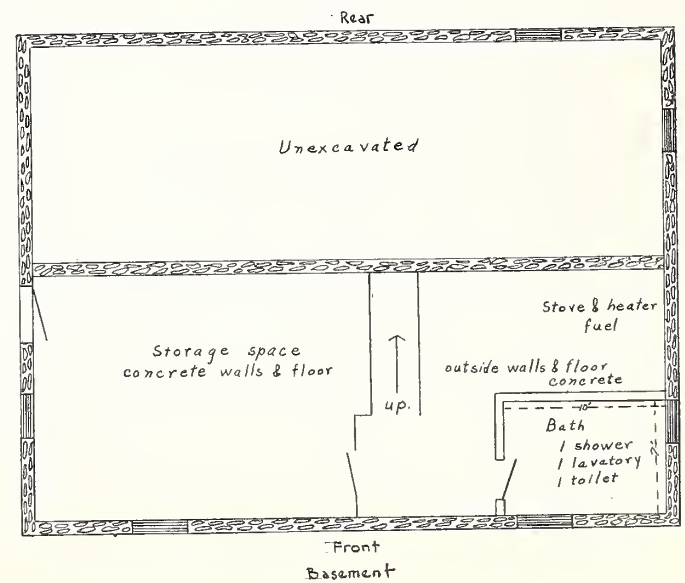
Fig. 49 - Part 2

Outside:
Full concrete foundation, ½ basement.
Rustic siding - painted.
⅓ pitch roof - cedar shingles.
Brick chimney 16" x 16", basement up.
Ceiling insulated.
Wired.
First Floor -
5 drops
4 switches
Second Floor
1 drop
1 switch
Basement
2 drops
2 switches
Floors, walls, and ceilings as shown on plat.
Plumbing:
Lavatory, shower, & toilet in basement plumbed to drain in cesspool.
Windows:
First Floor
2 D.H.D.W - 4 sash 2'4" x 2'10"
5 D. sliding - 10 sash 2' x 2'4"
1 D.H.SW - 2 sash 2'4" x 2'10"
Second Floor
2 D. sliding - 4 sash 2'4" x 2'8"
Basement
6 sash 1'8" x 2'9"

First Floor







C.S.W. 8/29/52

WARLAND RANGER STATION

Office - Warehouse Building

0 5 10 FT.

Fig. 49 - Part 3

Construction:
Sectional frame in 5 sections, walls 7½' high.
Outside - Rustic siding, painted.
Roof, ⅓ pitch, cedar shingles
2 doors, 2'8" x 6'8"
2 doors, 2'6" x 6'7"
13 windows, single sash 2'4" x 3', all 9-light.

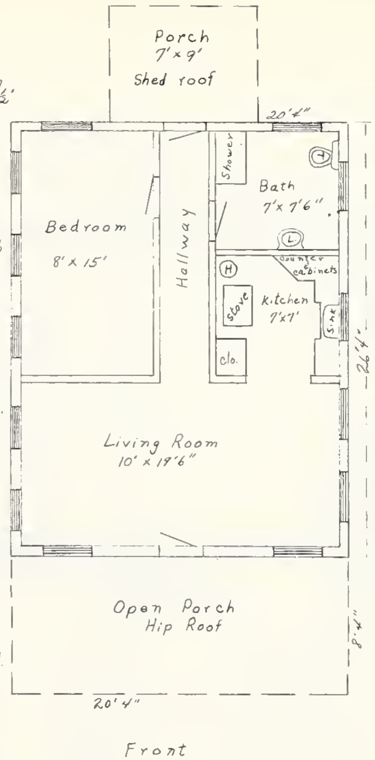
Inside:
Walls & ceilings of wallboard.
Knotty pine finish in Kitchen
Floors - 4" T.&G. Fir.
Linoleum, Kitchen & bath.

Wired:
4 drop lights
4 outlets
4 switches.

Plumbing:
Kitchen & bath plumbed to drain to cesspool.
Gravity pressure water.

Heat:
Living room - oil fuel heater.
Kitchen - wood fuel.

Foundation:
Treated Timber skids.
Roof Jack chimneys.



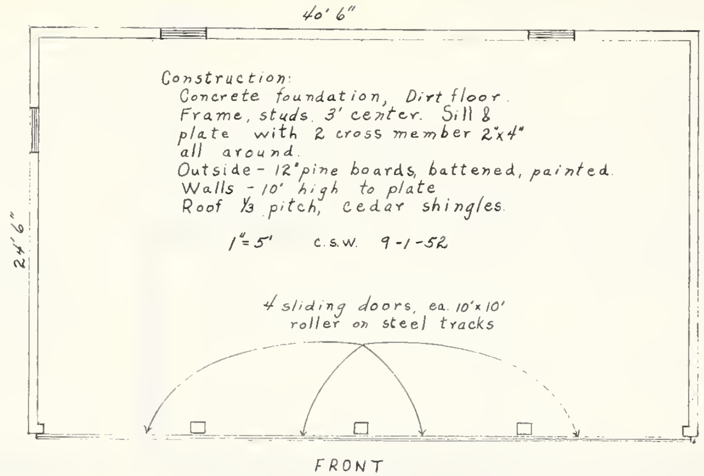
C.S.W.
9-1-52

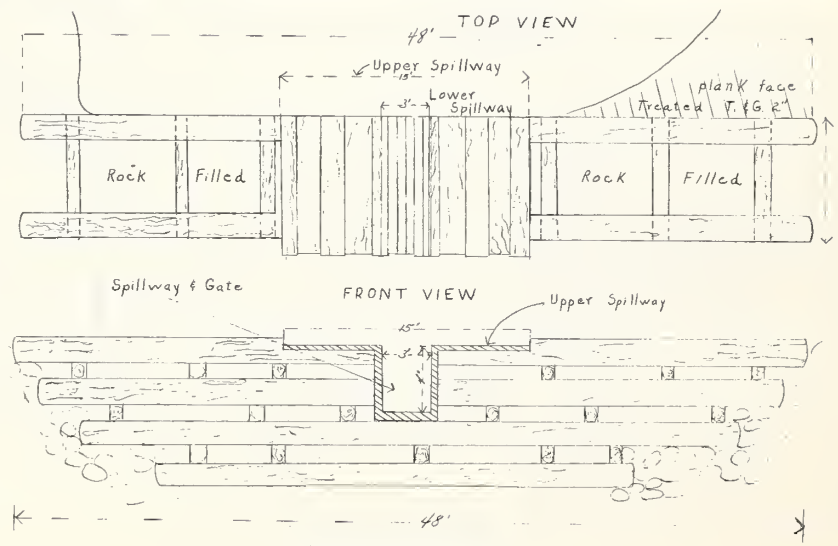
WARLAND RANGER STATION

Dwelling - Hdq. Guard

0 5 10 FT

TRUCK STORAGE SHED
4 Stall.





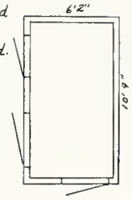
Warland Water Supply Dam
Log crib - Rock Filled
Reservoir 1600 Sq. ft - 4' depth

Fig. 49 - Part 4

WARLAND RANGER STATION — Miscellaneous Buildings

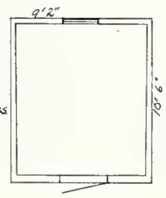
Generator House #1

Frame 6'2" x 10'9" o.s.
Vertical single board walls - painted
Roof, 1/4 pitch - Rubberoid.
Floor - Dirt.
Foundation - Treated 6"x6" on ground.
300 gal. fuel tank mounted on timber frame 3' high.
Small light plant inside.
3 Doors (2'8"x6'8", 3'6"x6' & 2'x2')



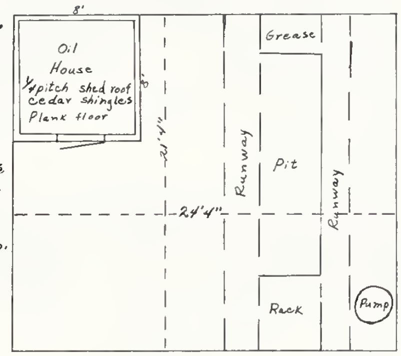
Generator House #2.

Frame 9'2" x 10'6" o.s.
2"x4" studs, 2"x6" rafters
Outside - 10" boards, horizontal, painted.
Roof 1/4 pitch - cedar shingles
1 Door. 3'x6'8"
1 Window, 2'4"x2'10", 9 L.
Foundation - T. Skids.
Inside, - Floor, ground.
Concrete block 16"x3'x6' machine mounting.
Large light plant inside.
1" = 5'



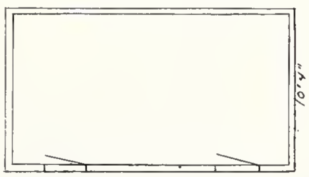
Truck Service

Oil House, Gas Station Greasing Rack,
1 Platform 21'4" x 24'4" on posts set on mud sills with 4-24' stringers, planked over with 2" plank
Grease rack is part of structure as shown.
Oil house 8'x8'-8' walls, frame, boarded and painted.
1 Door 3'x6'7"
Self measuring pump.
550 gal. underground fuel tank.
Entire platform planked outside of pit.



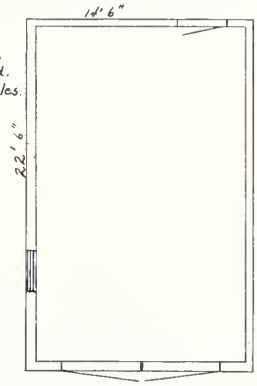
Ranger's Woodshed.

Frame Const.
Outside 10" boards, horizontal, painted.
Roof, 1/4 pitch, shed type, Rubberoid roofing.
2 Doors 2'10" x 6'8" home made.
Wooden floor.
No foundation



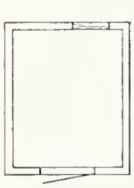
Ranger's Garage

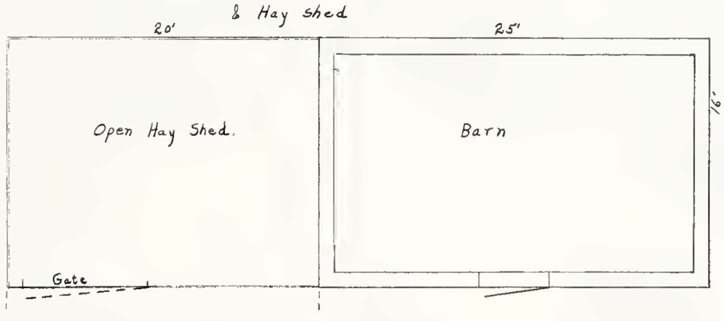
Frame Construction
Outside - Rustic siding, painted.
Roof 1/3 pitch, cedar shingles.
Foundation - concrete.
Floor & Door entrance apron - concrete.
1 Window 1'10" x 2'4" 4 light sash.
1 Door 3'x6'8"
2 Swing Doors each 5'x8'



Warland Barn & Hay shed

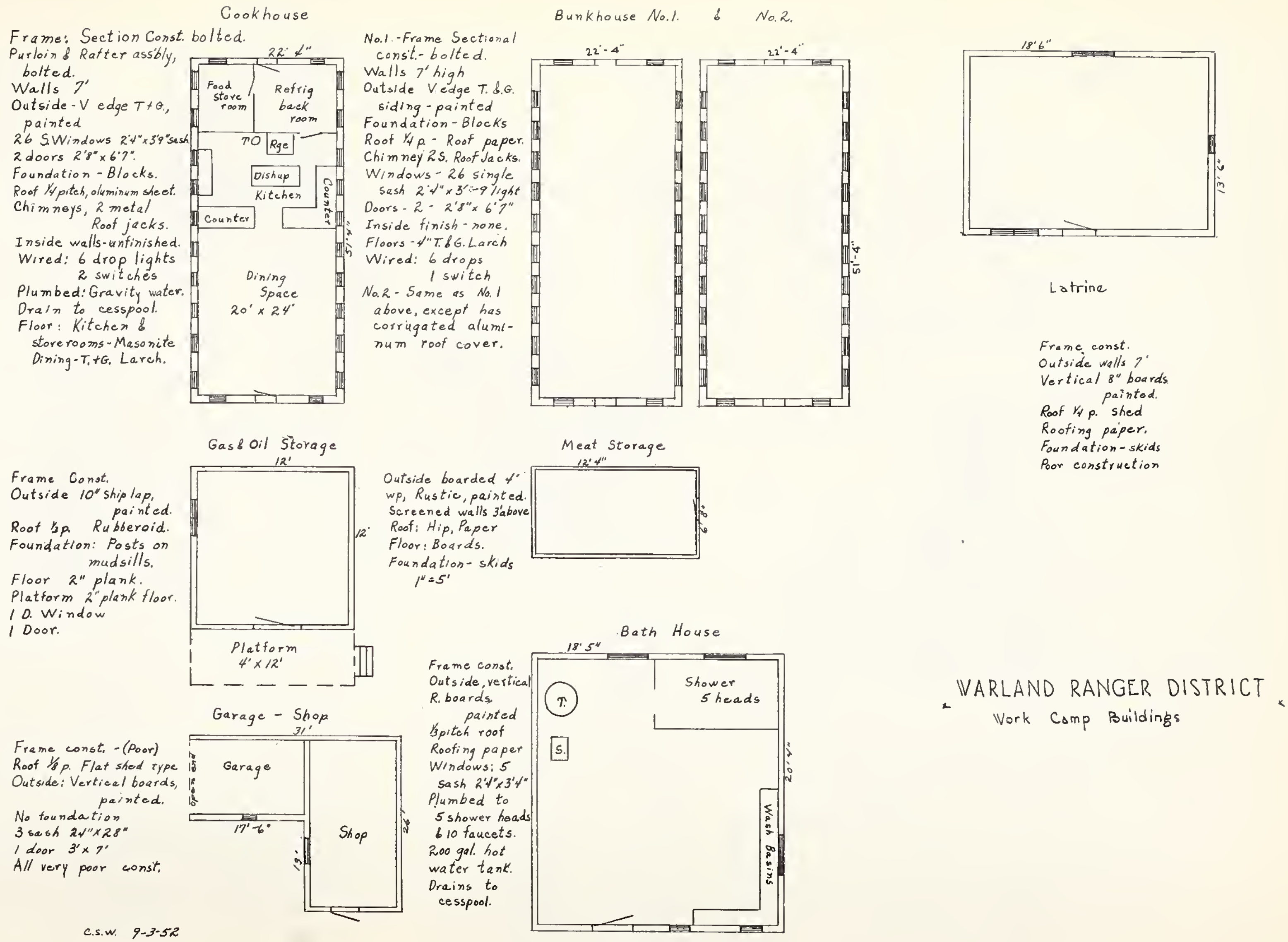
Saddle Shed 8'x9'8"





Construction: Barn 16'x25' of log construction, Hay storage section, 16'x20', of open crib const. One roof over all, 1/3 p., cedar shingles. Foundation - concrete blocks, 16"x16".
Saddle shed 8'x9'8"
Outside - rustic siding.
Roof; cedar shingles.
1 Door - 3' x 6'6"
1 Window, 28" x 28" sash.

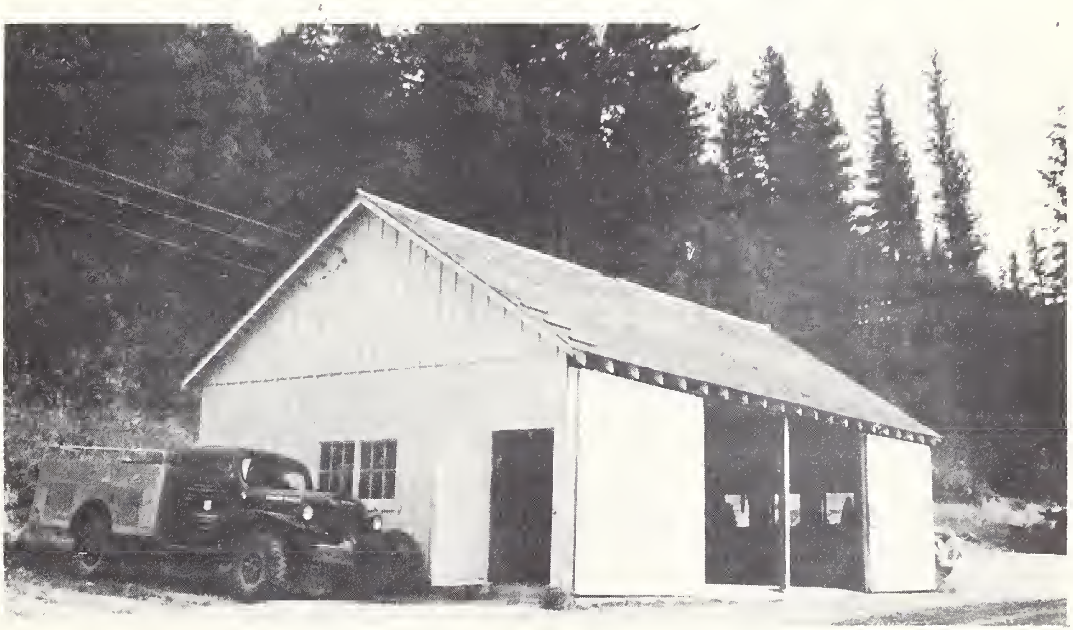
Fig. 49- Part 5



Cookhouse
Frame: Section Const. bolted.
Purloin & Rafter assbly, bolted.
Walls 7'
Outside-V edge T+G, painted
26 S.Windows 2'4"x3'9" sash
2 doors 2'8"x 6'7".
Foundation - Blocks.
Roof 1/4 pitch, aluminum sheet.
Chimneys, 2 metal Roof jacks.
Inside walls-unfinished.
Wired: 6 drop lights 2 switches
Plumbed: Gravity water.
Drain to cesspool.
Floor: Kitchen & storerooms-Masonite Dining-T.+G. Larch.
22' 4"
51' 4"
Food Stove room
Refrig back room
TO
Rge
Dishup
Kitchen
Counter
Counter
Dining Space 20' x 24'
Bunkhouse No. 1. & No. 2.
No. 1. - Frame Sectional const. - bolted.
Walls 7' high
Outside V edge T. & G. siding - painted
Foundation - Blocks
Roof 1/4 p. - Roof paper.
Chimney 2 S. Roof Jacks.
Windows - 26 single sash 2'4" x 3'-9 light
Doors - 2 - 2'8" x 6'7"
Inside finish - none.
Floors - 4" T. & G. Larch
Wired: 6 drops 1 switch
No. 2 - Same as No. 1 above, except has corrugated aluminum roof cover.
22'-4"
22'-4"
51'-4"
18'6"
13'6"
Latrine
Frame const.
Outside walls 7'
Vertical 8" boards painted.
Roof 1/4 p. shed
Roofing paper.
Foundation - skids
Poor construction
Gas & Oil Storage
12'
12'
Frame Const.
Outside 10" Ship lap, painted.
Roof 1/3 p. Rubberoid.
Foundation: Posts on mudsills.
Floor 2" plank.
Platform 2" plank floor.
1 D. Window
1 Door.
Platform 4' x 12'
Meat Storage
12'4"
6'8"
Outside boarded 4' wp, Rustic, painted.
Screened walls 3' above
Roof: Hip, Paper
Floor: Boards.
Foundation - skids
1" = 5'
Garage - Shop
31'
Garage
Shop
17'-6"
13'
24'
Frame const. - (Poor)
Roof 1/8 p. Flat shed type
Outside: Vertical boards, painted.
No foundation
3 sash 24" x 28"
1 door 3' x 7'
All very poor const.
Bath House
18' 5"
20' 4"
Frame const.
Outside, vertical R. boards, painted
1/3 pitch roof
Roofing paper
Windows: 5 sash 2'4" x 3'4"
Plumbed to 5 shower heads & 10 faucets.
200 gal. hot water tank.
Drains to cesspool.
T.
S.
Shower 5 heads
Wash Basins
WARLAND RANGER DISTRICT
Work Camp Buildings
C.S.W. 9-3-52

Fig. 49 - Part 6

Ranger dwelling



Garage-storage

Figure 50. Two buildings at the Rexford Ranger Station.

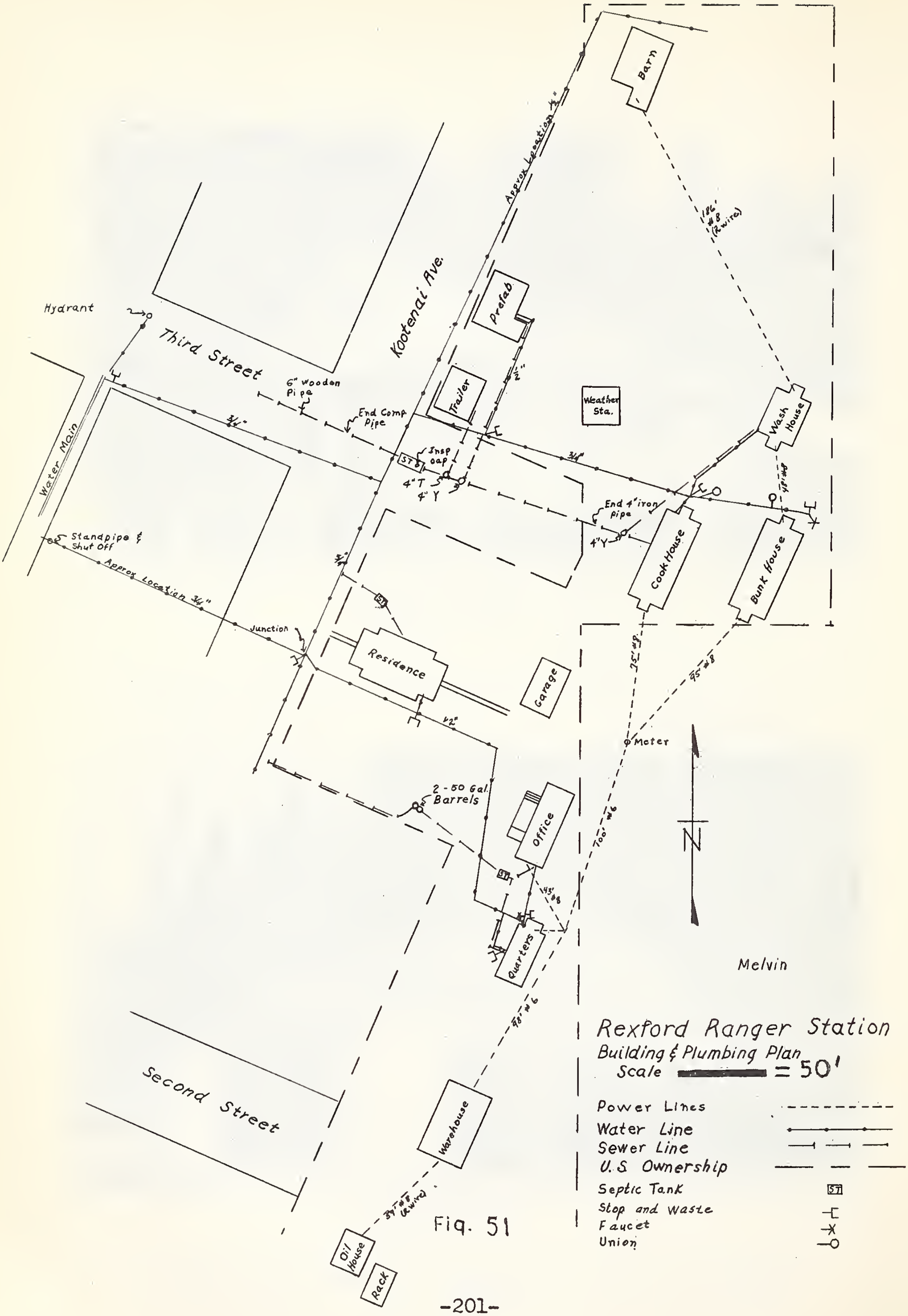
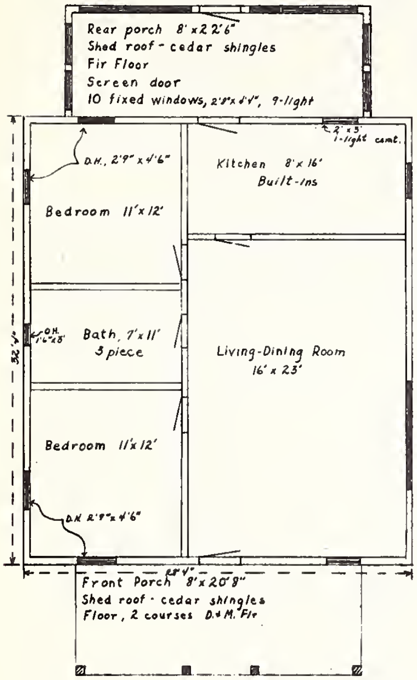

Hydrant
Third Street
6" wooden Pipe
End Comp Pipe
Kootenai Ave.
Approx Location 4"
Barn
186' #8 (2 wire)
Prefab
Trailer
Weather Sta.
Wash House
Water Main
3/4"
ST
Insp cap
4" T
4" Y
3/4"
End 4" iron pipe
4"Y
Cook House
Bunk House
48' #8
Standpipe & Shut Off
Approx Location 3/4"
Junction
Residence
Garage
75' #8
95' #8
1/2"
Meter
2 - 50 Gal. Barrels
Office
100' #6
ST
45' #8
Quarters
Melvin
Second Street
98' #6
Warehouse
37' #8 (2 wire)
Oil House
Rack
Rexford Ranger Station
Building & Plumbing Plan
Scale = 50'
Power Lines
Water Line
Sewer Line
U.S. Ownership
Septic Tank
Stop and Waste
Faucet
Union

Fig. 51

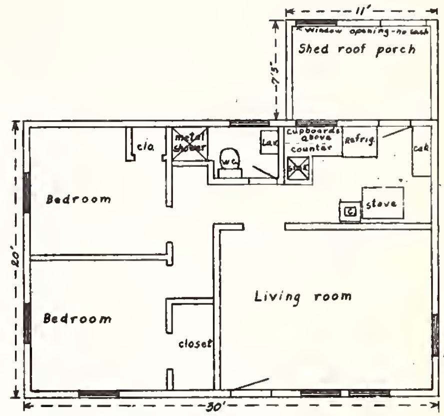
REXFORD RANGER STATION — Ranger's Dwelling



Full concrete basement.
Hotair furnace, coal or wood.
Insulation, blown-in rock wool throughout.
Roof - 1/3 pitch cedar shingles.
Outside - 1" lap siding, white.
Inside - wallboard over plaster.
Two small bedrooms upstairs.

PART 1

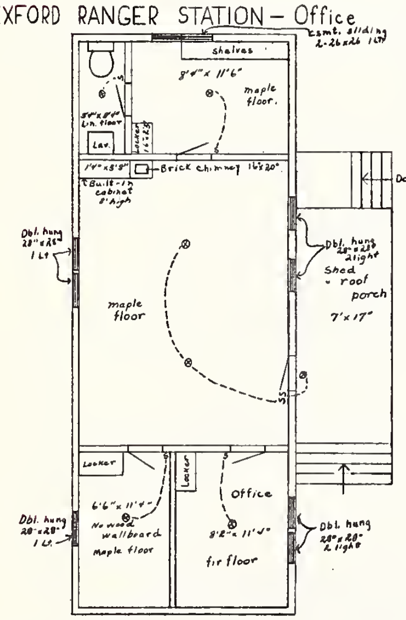
REXFORD RANGER STATION — Assistant ranger's dwelling.



Roof - 1/3 pitch, wood shingles.
Outside - Exterior grade plywood, white.
Inside - Plywood, natural finish
Floor - Larch
1 Door - 3' x 6'8" - 9 light
1 Door - 2'8" x 6'8" - 1 light
7 D.H. Windows - 2'10" x 4'6" - 6 light
2 Csmt. windows - 2'10½" x 3'5" - 9 light (kitchen & bath)
Rock wool insulation.

PART 2

REXFORD RANGER STATION — Office

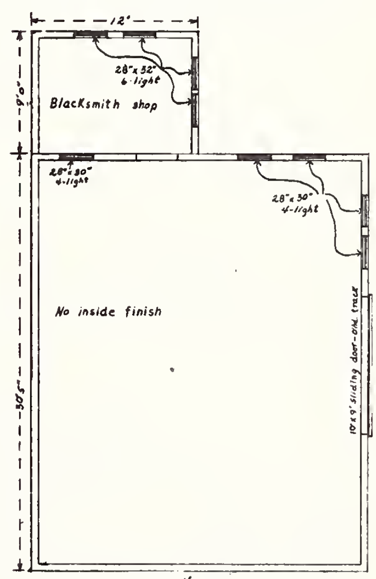


Foundation - concrete
Roof - 1/3 pitch, wood shingles
Outside - Lap siding, white 3½"
Basement - 12'6" x 17' concrete walls and floor.

Rock wool insulation.
1650 bf shelving in basement
30' antenna pole
40' flag pole

PART 3

REXFORD RANGER STATION — Barn

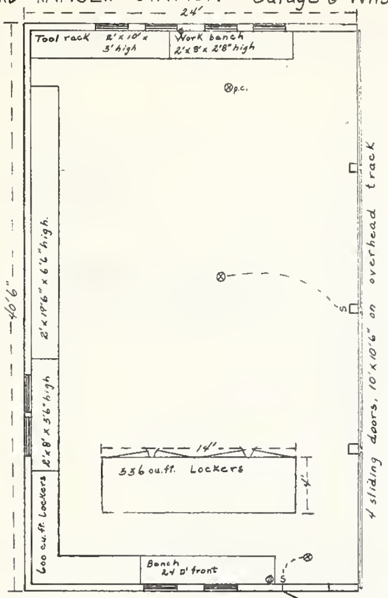


Foundation - concrete.
Floor - wood plank.
Roof - 1/3 pitch, cedar shingles.
Outside - 12" vertical boards & battens, white.

PART 4

Figure 52

REXFORD RANGER STATION – Garage & Whse.

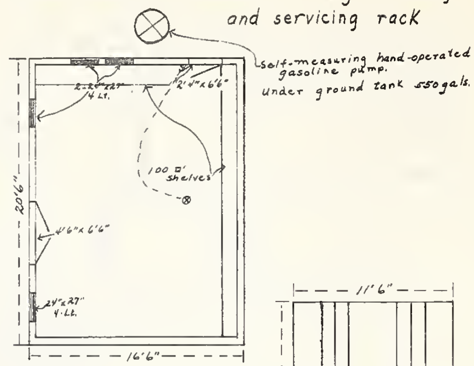


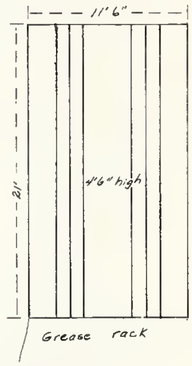
Foundation – concrete
Floor – concrete
Roof – 1/3 pitch – cedar shingles.
Outside – 12" Vert. Y.P. boards & battens, white

6 windows, 28"x52" – 4 light sash.
2 windows, 32"x38" 6 light sash.
1 door 5'4" x 6'6"
4 sliding doors.

PART 5

REXFORD RANGER STATION – Oil & gas storage and servicing rack

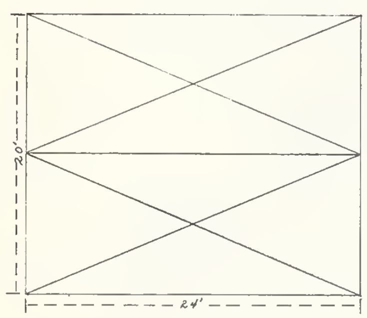




Foundation – timber on rock.
Roof – wood shingles
Outside – Vertical boards battens, white
Floor – dirt.

PART 6

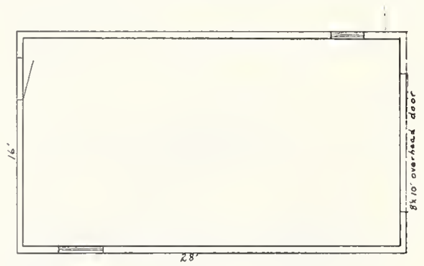
REXFORD RANGER STATION – Timber sales officer's residence



Two (2) Brown Trailer Bodies, side-by-side.
Model FSC, Serial No. 7956
Glass wool insulation

PART 7

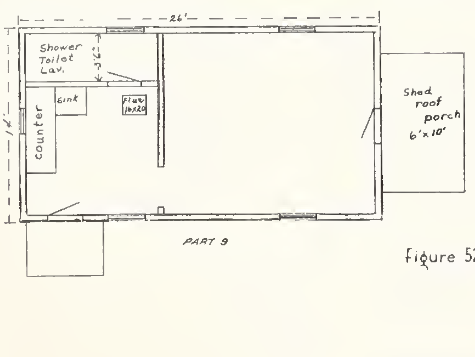
REXFORD RANGER STATION – Ranger's Garage



Frame construction
Concrete foundation
Inside – unfinished
Outside – rustic siding, painted white.
Roof – 1/3 pitch, cedar shingles.
Floor – dirt & gravel
1 8'x10' overhead door
1 3'x6'8" panel door
1 DH. window, 2'4" x 4'8". 4 light ea.
1 Fixed window, 3'2" x 2'8", 9 light

PART 8

REXFORD RANGER STATION – Bunkhouse

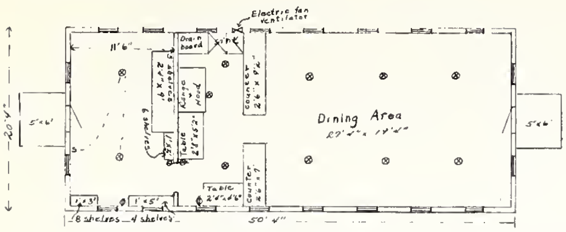


Roof – 1/3 pitch, wood shingles.
Outside – Rustic siding, white
2 Double hung windows, 32"x32" 6-light sash
2 - 32"x34" 6-light sash.
1 - 20"x24" 4-light sash.
2 doors 2'6"x6'6"
Wired

PART 9

Figure 52

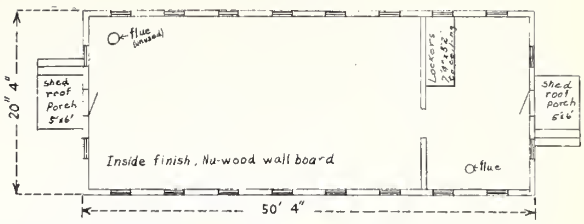
REXFORD WORK CAMP- Cook & Mess-hall



Foundation - 25-7"x9" concrete piers.
Roof - 1/3 pitch, cedar shingles
2 galv. iron roof jacks.
Outside - Vertical boards & battens, white.
20 csmt. windows, 27"x33", 9-light.
2 Doors.
Fir floors - painted.
Wired.

PART 10

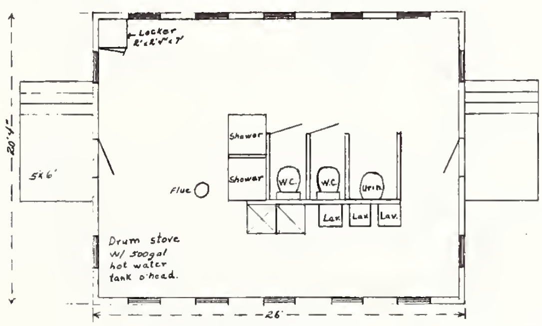
REXFORD WORK CAMP – Bunkhouse



Foundation - 25-7"x7" concrete piers.
Roof - 1/3 pitch, cedar shingles.
2 galv. iron roof jacks
Outside - Vertical boards & battens, white.
22 csmt. windows, 27"x33", 9-light
2 Doors
Fir floors, painted
Wired

PART 11

REXFORD WORK CAMP - Laundry & Bath-house



Foundation - 12 concrete piers (7"x7").
Roof - 1/4 pitch, corr. aluminum roofing.
Outside - 4" T.&G., horiz., white.
Galv. iron roof jack chimney
Inside - 1"x8" horiz., white, no ceiling.
Floor - 1"x4" Fir, painted.
14 csmt. windows - 27"x33", 9-light.
2 - 5-panel doors, 2'6"x6'6".
Wired
2 - csmt windows, 26"x26" gable ends.

PART 12

Figure 52

In Study 3 the Warland District headquarters would also be moved to Wolf Creek and the work center to Warland Creek. The Rexford Ranger District headquarters would be located at Eureka and the work center at Big Creek. As no new district would be created, Big Creek would be within the Rexford District.

Replacement of communications

The costs of replacing communication facilities are based on 1952 construction costs. The construction cost index of the Engineering News Record increased 38.5 percent between 1947 and 1952. If the future index is sharply up or down, a revision of these estimates will be necessary.

At first glance, the telephone construction costs may seem high. However, these figures are based on the cost of the 42-mile Coram-Spotted Bear metallic circuit which the Bureau of Reclamation built on the Flathead Forest to replace the metallic line which was destroyed. The Bureau contracted the job and that would probably be the case on this project.

The telephone construction work would not be done until the project was nearly completed since it would have to follow the road construction. During the construction period the fire hazard would be greatly increased and the telephone system would be subject to constant breakage and poor service. It would be absolutely essential that an adequate radio system be installed at the very beginning of the project.

Figure 53 shows the communication facilities which would be required for Study 1. Exactly the same facilities would be needed for Study 2. Table 87 summarizes the cost of these communication replacements. The details of the Studies 1 and 2 communication estimates are shown in the supplement to table 87. The same information for Study 3 is presented in figure 54 and table 88.

General national forest administration and fire control

The costs of operating the national forests are discussed here under three headings: overhead, basic fire control, and additional fire suppression. Travel costs are not included. They are discussed in Appendix C.

If the road plans of either Study 1 or Study 2 were adopted, the overhead administration organization would need to be shifted and expanded to handle its job properly. The net effect of these changes would be to increase overhead national forest costs by $12,190 annually. If the Study 3 road plan were adopted, no expansion of overhead organization over Study 0 would be necessary. Table 89 summarizes the overhead costs for Studies 0, 1, and 2.

The basic fire control job would be affected by a big dam no matter what transportation plan were adopted. The reservoir would constitute a barrier, making difficult the movement of men and materials. Thus,

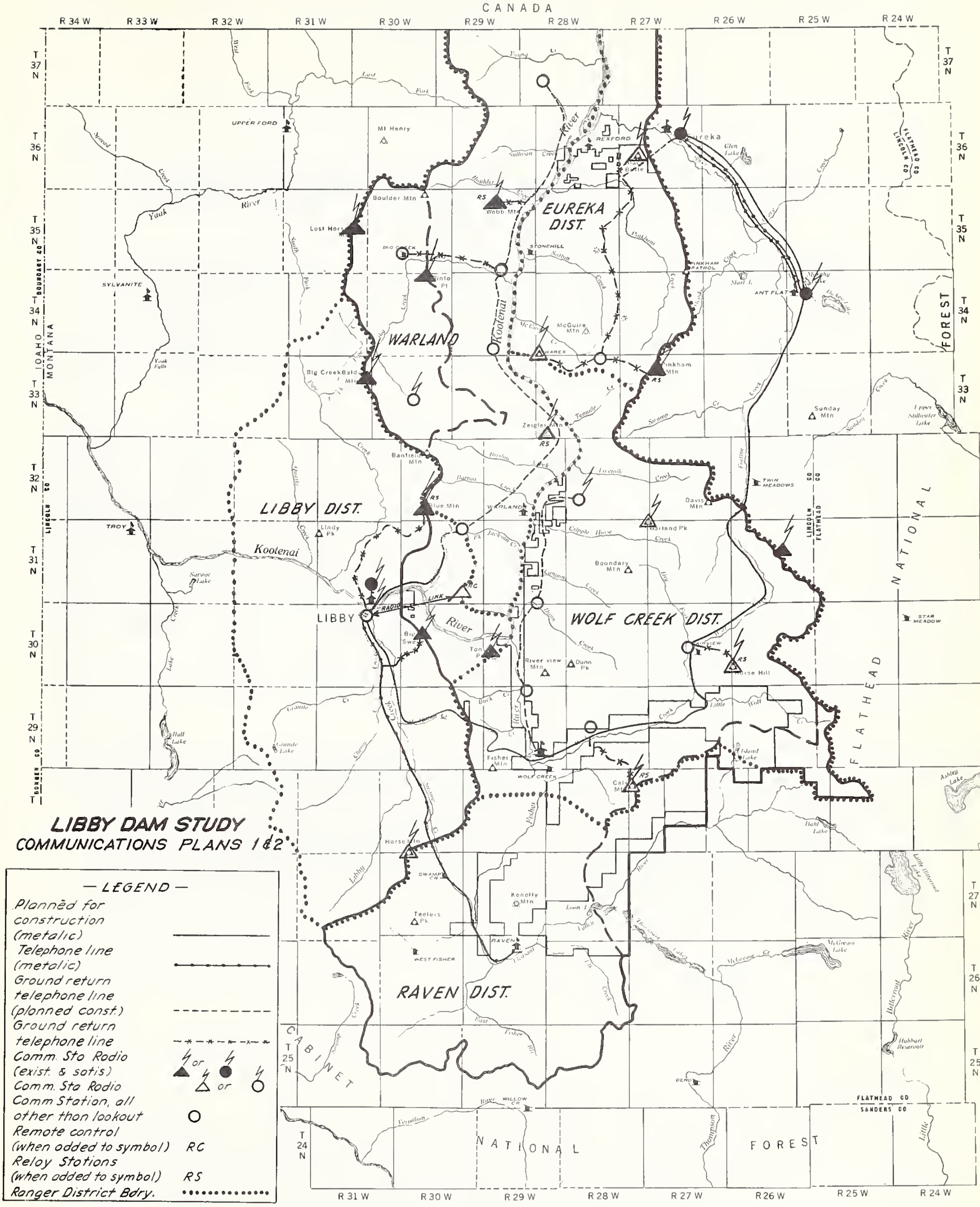

CANADA
LIBBY DAM STUDY
COMMUNICATIONS PLANS 1&2
— LEGEND —
Planned for construction (metalic)
Telephone line (metalic)
Ground return telephone line (planned const.)
Ground return telephone line
Comm. Sta Radio (exist. & satis.)
Comm. Sta Radio
Comm Station, all other than lookout
Remote control (when added to symbol) RC
Relay Stations (when added to symbol) RS
Ranger District Bdry.
EUREKA DIST.
WARLAND
LIBBY DIST.
WOLF CREEK DIST.
RAVEN DIST.
LIBBY
Kootenai
FLATHEAD NATIONAL FOREST
CABINET NATIONAL FOREST

Fig. 53

Table 87. Cost of restoring communication facilities

Studies 1 and 2

Item	Quantity	Cost
	Miles	Dollars
Telephone line		
Libby-Eureka[1]	97	235,175
Eureka-Pinkham Creek	6	6,200
Wolf Creek Ranger Station-Warland Creek work center	35	34,500
Libby-Dodge Creek	64	73,750
Subtotal	202	349,625
Removal of old telephone line[2]	63	2,025
Radios (13 sets)		11,270
Removal and installation of Rexford radio		250
Remote control radio for Libby Ranger Station		5,000
Radio power plants for Wolf Creek Ranger Station and Warland Creek work center		9,000
Total		377,170

1/Line now under lease to General Telephone Company. Cost estimate is largely for continuation of commercial service for the public. For national forest purposes alone, radio might suffice.

2/Only telephone line outside the flowage. No charge made for line removal in flowage area since it is supposed that this will be taken care of when the area is cleared.

Table 87 supplement. Detailed estimate of costs of restoring communication facilities

Studies 1 and 2

	Dollars
Libby-Eureka telephone line	
Metallic circuit on poles of Libby-Raven line, 4 miles at $500 a mile	2,000
Circuit metallic bracket line, 78 miles at $2500 a mile	195,000
Metallic circuit on poles of Eureka-Ant Flat line, 15 miles at $500 a mile	7,500
Subtotal (97 miles)	204,500
Construction costs added for surveys, office drafting, supervision, and overhead (15 percent)	30,675
Total	235,175
Rexford District	
Telephone	
Construction. Eureka to junction with Pinkham line.	
Circuit metallic bracket line, 2 miles at $2500 a mile	5,000
Ground return circuit, 4 miles at $300 a mile	1,200
Line removal (abandoned lines)	
Metallic, Rexford to Eureka, 9 miles at $75 a mile	675
Ground return circuit, Rexford to Black Butte spur, 4 miles at $25 a mile	100
Radio	
Removal and installation of radio equipment from Rexford to Eureka; material $150, labor $100	250
Warex Lookout.	
FM backpack radio $440, antenna and material $50, labor and travel $50. This is a primary lookout for fire control during clearing operations in flowage area.	540
Prevention guard. Radio, FM mobile. For use by fire guard in flowage area.	750
Tanker (fire). Radio, FM backpack and mobile antenna	465
Wolf Creek District	
Telephone	
Construction. Wolf Creek Ranger Station to Warland Creek Station	
Ground return pole line, 20 miles at $1500 a mile	30.000
Ground return tree line, 15 miles at $300 a mile	4,500
Line removal. Warland to Five Mile Creek	
Ground return line, 6 miles at $25 a mile	150

Table 87 supplement. Detailed estimate of costs of restoring communication facilities (Cont.)

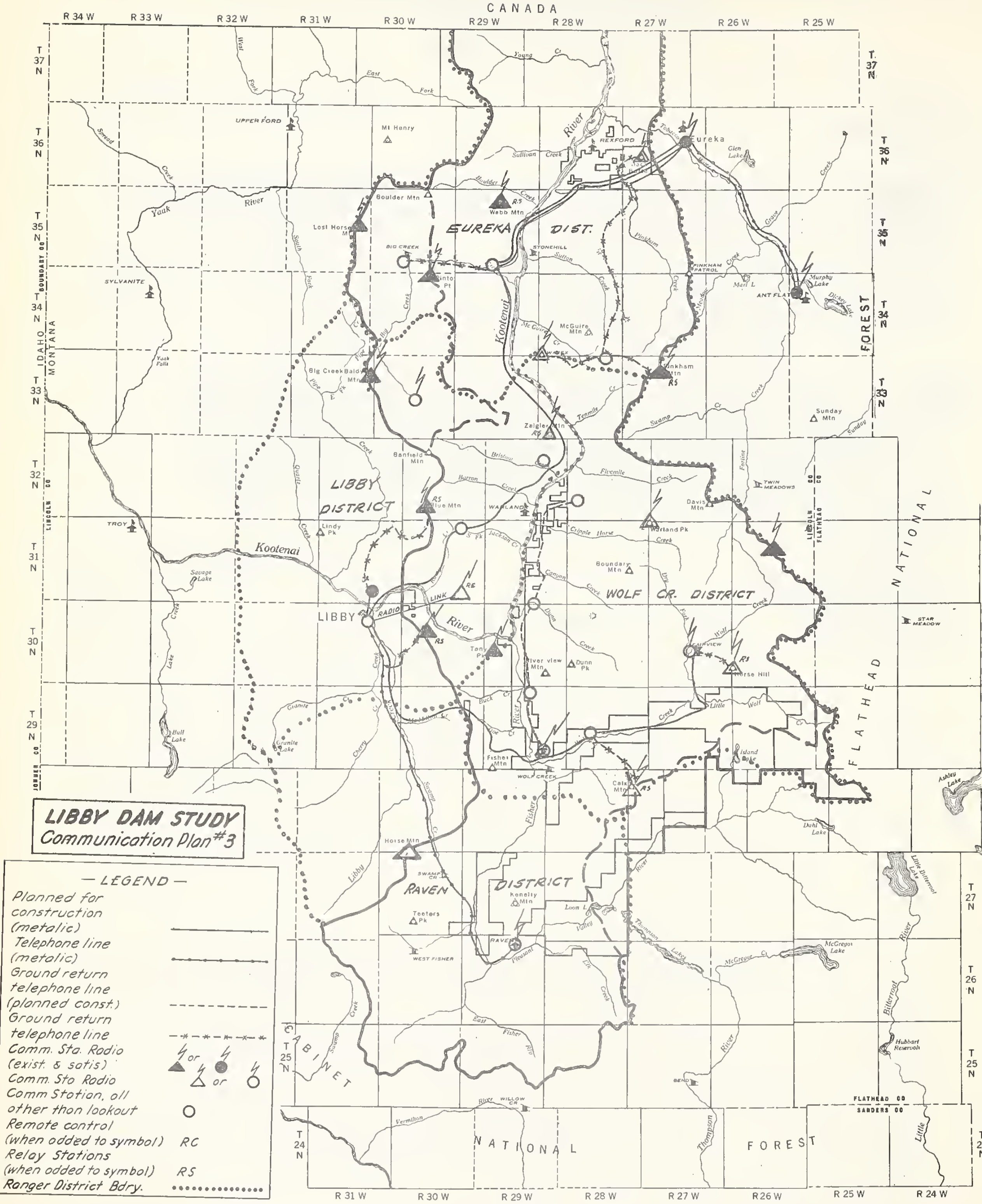
Studies 1 and 2

	Dollars
Wolf Creek District (Cont.)	
Radio	
Wolf Creek Ranger Station. Central station, FM 50 watts $1760, antenna and material $300, labor $50	2,110
Warland Creek Station. Radio, FM backpack $440, antenna and material $125, labor $50	615
Prevention guard. Radio, FM mobile. For use of ranger or guard to increase fire control and flowage area.	750
Power plant. Wolf Creek Ranger Station. A 10 kw diesel electric plant would be needed here to furnish power for all purposes. Such a plant, complete with controls, storage tank, pipe, and wiring would cost $4500. The smallest diesel plant available (3 kw) which would be sufficient for radio power would cost $1500. This amount should be charged against communication and the remaining $3000 against other uses.	4,500
Warland District	
Telephone	
Construction. Ground return circuit line extending from boundary of Libby District to fireman cabin on Dodge Creek.	
Ground return pole line, 20 miles at $1500 a mile	30,000
Ground return tree line, 30 miles at $300 a mile	9,000
Line removal. Ground return line, Ziegler Mountain to Bristow Creek, 4 miles at $25 a mile	100
Ground return line, Warland to Point 15, 21 miles at $25 a mile	525
Ground return line, Wolf Creek Ranger Station to Fairview, 19 miles at $25 a mile	475
Radio	
Warland Ranger Station. Central station, FM 50 watts $1760, antenna and material $300, labor $50, power plant 10 kw diesel $4500	6,610
Ziegler Mountain Lookout. Relay set FM lookout $850, material and antennas $100, labor $100	1,050
Prevention guard. Radio, FM mobile. For use of fire guard in flowage area.	750
Tanker (fire). Radio, FM backpack and mobile antenna	465
Maintenance and fire crew. Radio, FM backpack	450

Table 87 supplement. Detailed estimate of costs of restoring communication facilities (Cont.)

Studies 1 and 2

	Dollars
Libby District	
Telephone	
Construction. This circuit extends from Libby Ranger Station to boundary of Libby District where it joins the line on the Warland District.	
Circuit metallic bracket line, 10 miles at $2500 a mile	25,000
Survey and overhead (15 percent)	3,750
Ground return pole line, 4 miles at $1500 a mile	6,000
Radio	
Remote control. Station on Zonolite Ridge. This installation is essential if adequate radio coverage is to be secured over the flowage area for fire control purposes during the construction period. The central station is now located at the Libby Ranger Station. Radio link 400 mc $3000; cement block shelter 8' x 10', $1000; antennas (5) $500; material $350; labor $150	5,000
Prevention guard. Radio, FM mobile. For use by fire guard in flowage area.	750
Tanker (fire). Radio, FM backpack and mobile antenna	465



LIBBY DAM STUDY
Communication Plan #3
— LEGEND —
Planned for construction (metalic)
Telephone line (metalic)
Ground return telephone line (planned const.)
Ground return telephone line
Comm. Sta. Radio (exist. & satis.)
Comm. Sta. Radio
Comm. Station, all other than lookout
Remote control (when added to symbol) RC
Relay Stations (when added to symbol) RS
Ranger District Bdry.
CANADA
R 34 W
R 33 W
R 32 W
R 31 W
R 30 W
R 29 W
R 28 W
R 27 W
R 26 W
R 25 W
R 24 W
T 37 N
T 36 N
T 35 N
T 34 N
T 33 N
T 32 N
T 31 N
T 30 N
T 29 N
T 28 N
T 27 N
T 26 N
T 25 N
T 24 N
IDAHO
MONTANA
EUREKA DIST.
LIBBY DISTRICT
WOLF CR. DISTRICT
RAVEN DISTRICT
Eureka
REXFORD
LIBBY
TROY
Kootenai
River
Yaak
RADIO LINK
Webb Mtn
Boulder Mtn
Mt Henry
McGuire Mtn
Pinkham Mtn
Zeigler Mtn
Banfield Mtn
Lindy Pk
Boundary Mtn
Warland Pk
Davis Mtn
Horse Hill
Dunn Pk
River view Mtn
Fisher Mtn
Horse Mtn
Teeters Pk
Kenelty Mtn
Sunday Mtn
Big Creek Baldy Mtn
Lost Horse Mtn
Pinto Pt
UPPER FORD
SYLVANITE
STONEHILL
PINKHAM PATROL
ANT FLAT
TWIN MEADOWS
STAR MEADOW
WARLAND
WOLF CREEK
SWAMP CR
WEST FISHER
RAVEN
WILLOW CR
Murphy Lake
Dickey Lake
Glen Lake
Savage Lake
Bull Lake
Granite Lake
Island Lake
Loon L
McGregor Lake
Little Bitterroot Lake
Ashley Lake
Dahl Lake
Hubbart Reservoir
CABINET
NATIONAL FOREST
FLATHEAD NATIONAL FOREST
FLATHEAD CO
SANDERS CO

Fig. 54

Table 88. Cost of restoring communication facilities

Study 3

Item	Quantity	Cost
	Miles	Dollars
Telephone line		
Libby-Eureka[1]	65	205,850
Libby-Wolf Creek Ranger Station	25	46,575
Wolf Creek Ranger Station-Fairview	19	9,500
Wolf Creek Ranger Station-Warland	35	34,500
Webb Mountain Lookout	$1\frac{1}{2}$	450
Subtotal	$145\frac{1}{2}$	296,875
Removal of old telephone line[2]	44	1,550
Radios (9 sets)		6,985
Removal and installation of Rexford equipment		250
Remote control radio for Libby Ranger Station		5,000
Radio power plant for Wolf Creek Ranger Station		4,500
Total		315,160

1/Line now under lease to General Telephone Company. Cost estimate is largely for continuation of commercial service for the public. For national forest purposes alone, radio might suffice.

2/No charge made for line removal in flowage area since it is supposed that this will be taken care of when the area is cleared.

Table 88 supplement. Detailed estimate of costs of restoring communication facilities

Study 3

	Dollars
Libby-Eureka telephone line	
Metallic circuit crossarm line, 8 miles at $3500 a mile	28,000
Metallic circuit crossarm line, 17 miles at $3000 a mile	51,000
Metallic circuit bracket line, 40 miles at $2500 a mile	100,000
Subtotal (right-of-way clearance included)	179,000
Construction costs added for surveys, office drafting, supervision and overhead (15 percent)	26,850
Total	205,850
Rexford District	
Telephone	
Construction. Ground return line from Boulder Creek to new bridge to connect Webb Mountain Lookout, 1½ miles at $300 a mile	450
Line removal (abandoned lines)	
Rexford-Eureka, 9 miles at $75 a mile	675
Rexford-Black Butte spur ground return, 4 miles at $25 a mile	100
Radio	
Removal and installation of radio equipment from Rexford to Eureka; material $150, labor $100	250
Warex Lookout.	
FM backpack radio $440, antenna and material $50, labor and travel $50. This is a primary lookout for fire control during clearing operations in flowage area.	540
Prevention guard. Radio, FM mobile. For use by fire guard in flowage area.	750
Tanker (fire). Radio, FM backpack and mobile antenna	465
Warland District	
Telephone	
Construction. Libby to Wolf Creek Ranger Station. Circuit on poles of Libby-Raven line, 11 miles at $500 a mile	5,500
Metallic bracket construction, 14 miles at $2500 a mile	35,000
Construction cost added for surveys, office drafting, supervision, and overhead (15 percent)	6,075
Wolf Creek Ranger Station to Fairview. Circuit on Great Northern Railway poles, 19 miles at $500 a mile	9,500
Wolf Creek Ranger Station to Warland Station	
Ground return pole line, 20 miles at $1500 a mile	30,000
Ground return tree line, 15 miles at $300 a mile	4,500
Line removal. Ground return line, Warland-Five Mile Creek, 6 miles at $25 a mile	150

Table 88 supplement. Detailed estimate of costs of restoring communication facilities (Cont.)

Study 3

	Dollars
Warland District (Cont.)	
Radio	
Wolf Creek Ranger Station. Central station FM 50 watts $1760, antenna and material $300, labor $50	2,110
Warland Station. Radio, FM backpack $440, antenna and material $125, labor $50	615
Prevention guard. Radio, FM mobile. For use of ranger or guard to increase fire control in flowage area.	750
Power plant. Wolf Creek Ranger Station. A 10 kw diesel electric plant would be needed at the Wolf Creek Ranger Station to furnish power for all purposes. Such a plant complete with controls, storage tank, pipe, and wiring would cost $4500. The smallest diesel plant available (3 kw) which would be sufficient for radio power would cost $1500. This amount should be charged against communication and the remaining $300 against other uses.	4,500
Libby District	
Telephone	
Line removal. Ziegler Mountain to Bristow Creek, ground return line, 4 miles at $25 a mile	100
Warland to Point 15, ground return line, 21 miles at $25 a mile	525
Radio	
Libby Ranger Station. Remote control to Zonolite Ridge. This installation is essential if adequate radio coverage is to be secured over the flowage area for fire control purposes during the construction period. The central station is now located at the Libby Ranger Station. Radio link 400 mc $3000; cement block shelter 8' x 10', $1000; antennas (5) $500; material $350; labor $150	5,000
Ziegler Mountain Lookout. Radio, FM backpack $440, antenna and material $50, labor and travel $50	540
Prevention guard. Radio, FM mobile. For use by fire guard in flowage area.	750
Tanker (fire). Radio, FM backpack and mobile antenna	465

Table 89. Overhead national forest administration costs

Studies 0, 1, and 2

Ranger district	Position and item	Annual cost: Study 0	Annual cost: Studies 1 and 2	Difference
		- - - - - - Dollars	- - - - - -	- - - - - -
Rexford	Ranger	5,560	5,560	
	Assistant ranger	4,330	-	
	Ranger alternate	3,910	3,910	
Subtotal		13,800	9,470	- 4,330
Warland	Ranger	5,560	5,560	
	Assistant ranger	-	4,330	
	Ranger alternate	3,910	3,910	
Subtotal		9,470	13,800	+ 4,330
Libby	Ranger	1,112	1,112	
Use 20 percent of total for application to zone	Assistant ranger	866	866	
	Ranger alternate	782	782	
Subtotal		2,760	2,760	-
Raven	Ranger	5,560	5,560	
	Ranger alternate	(2) 7,820	(1) 3,910	
Subtotal		13,380	9,470	- 3,910
Wolf Creek	Ranger	-	5,560	
	Assistant ranger	-	4,330	
	Ranger alternate	-	3,910	
	$1\frac{1}{2}$-ton truck	-	800	
	3/4-ton pickup	-	700	
	2 saddle horses	-	200	
	6 pack mules	-	600	
Subtotal		-	16,100	+ 16,100
Total		39,410	51,600	+ 12,190

the job would become more difficult. There would be an especially critical situation during the construction period. For four or five years there would be much activity widely scattered along the valley bottom. Men, camps, and machinery would be everywhere. If the flowage clearing extended 15 feet above the highwater mark, about 40,000 acres would be logged and the debris burned. The hazards created by large numbers of men, internal combustion machinery, and debris burning would be aggravated by the fact that the pressures would require continuing the work through the summer season if at all possible.

The fire control objective should be to log the flowage area and clear and burn the debris there and elsewhere without any fires escaping. This is essential because fires which get away could fan out fast, run up slopes rapidly, and prove extremely difficult and expensive to control.

During the construction period there would be need for special wardens and patrols. Likewise, there would be need for close cooperation among the federal agencies involved throughout the construction period. We should attempt to:

1. Provide complete detection coverage over the flowage and other areas of logging, clearing, and burning. Because of increased hazards, it would be necessary to provide this detection coverage for a longer period each year than is presently necessary. During some years such protection might be required from April through November.

2. Provide firemen right on the ground as prevention guards to deal directly with contractors to see that fire suppression equipment, caches, etc. are always ready and properly located, and crews are organized and trained, ready to go in case a clearing fire or other fire should escape. The prime objective of these on-the-ground firemen should be to keep the contractor, overhead, and crews constantly alert to the fire hazard, to establish and enforce an adequate burning permit system, smoking and lunch fire rules, equipment and building inspection, and other measures necessary to assure that fires are not started accidentally and that those necessary in connection with the work do not get away.

The extra guards, etc. required to do this job would cost $27,310 a year (table 90). This expense should be borne by the dam project.

Table 90. Present and future cost of the basic organization required for fire prevention, fire detection, and initial fire suppression action, Zone of Influence

	Total annual cost	Increase over Study 0	Overload
	Dollars		
Study 0	47,312	-	8,206
Construction period	74,622	27,310	8,206
Following construction			
Studies 1 and 2	58,888	11,576	7,150
Study 3	49,897	2,585	7,020

Following construction of the dam, the fire control organization could be decreased somewhat. However, with the road systems planned under Studies 1 and 2, it would be necessary to spend almost $15,600 a year more for basic fire control than under Study 0. With the road system proposed in Study 3, fewer additional fire guards would be needed. Thus, the annual cost of the basic control organization would be only $2600 higher than with Study 0. The basic requirements to handle fire danger conditions rated 70 or less are shown in column 1 of table 90. The additional costs which would be involved when the fire danger climbs above 70 are shown in column 3.

Figures 55, 56, 57, and 58 and tables 92, 93, 94, and 95 show the present fire control organization and the organization which would be required with each postdam road plan.

If the basic fire control organization were completely successful, it would detect all fires promptly and extinguish them without any help. However, it is a rare year when this is possible. On bad fire days some fires will spread in spite of best initial action, and costs far in excess of those shown in table 90 may be incurred. When it becomes necessary to move large crews and heavy equipment onto the line within a few hours, roads are important. Existing roads permit this to be done anywhere within the Zone of Influence. Speeds from 20 to 50 miles an hour are possible on these roads.

Men for hand work in fire fighting are scarce. More dependence must be placed on bulldozers and other machines. One bulldozer, for example, will accomplish the work of 25 to 50 men building fire line. These machines frequently have to be moved a long distance to reach the fire. A large percentage of the area within the Zone of Influence is suitable for the use of bulldozers and trenchers for fire line construction (figure 59). Without an adequate road system over the area, there would be no chance of getting this effective fire-fighting equipment to going fires in time to do any good.

Table 91 shows that within the Zone of Influence the Kootenai National

Table 91. Average number of fires a year by size of burn, 1931-1950, Zone of Influence

	Number of fires by area of individual fire					
	Less than ¼ acre	¼ to 10 acres	10 to 100 acres	100 to 1000 acres	Over 1000 acres	Total
Lightning	26.40	6.00	.60	.10	.05	33.15
Railroad	1.30	.70	.25	-	-	2.25
Lumbering	.20	.15	-	-	-	.35
Camper	.50	.10	-	-	-	.60
Smoker	2.00	.80	.40	-	-	3.20
Debris burning	.15	.10	.05	-	-	.30
Incendiary	.15	.05	-	-	-	.20
Miscellaneous	.15	.05	-	-	-	.20
Total	30.85	7.95	1.30	.10	.05	40.25

Table 92. Existing (1952) fire control organization plan for Zone of Influence

POSITIONS: Station	Title	Location: Sec.	Twp.	Rng.	Fire danger	Fire control occupancy: From	To	Pay periods: Spring	Summer	Total	Travel exp.	No. men	Cost Normal Season
Libby Sup. Office	F. Disp.	3	30	31		4/10	11/15	6.0	10.0	16.0	75	1	
" " "	T. Driv.					6/1	10/15	2.0	7.5	9.5		2	
" " "	Com. Asst.					5/15	9/10	3.0	5.0	8.0		3	
" " "	A. Obser.				33	6/16	9/15	1.0	5.5	6.5		4	
" " "	Whseman.					7/1	9/20		6.0	6.0		5	
Observation					Flying Time			20 hrs	155 hrs	175 hrs			
						(Expense included below)							
				Total	Normal Season Cost			$6,056					
				Use	50% for Zone of Influence								$ 3,028.00
Rexford R.S.	R. Alt.	15	36	28		4/21	11/15	5.0	9.0	14.0	25	6	
" "	Disp.					5/16	9/5	3.0	5.0	8.0	25	7	
" "	Packer					6/1	10/15	2.0	7.5	9.5		8	
" "	F.				27	6/1	9/30	2.0	6.5	8.5	20	9	
Black Butte	L.O.F.	20	36	27	35	6/16	9/5	1.0	5.0	6.0		11	
Webb Mt.	L.O.F.	10	35	29	44	6/21	9/5	.5	5.0	5.5		12	
Warex Mt.	L.O.F.	6	33	28	52	6/26	9/5	.5	5.0	5.5		13	
Rexford R.S.	F.	15	36	28	70	7/6	8/31		4.0	4.0		14	10,500.00
Warland R.S.	R. Alt.	34	32	29		5/6	10/20	4.0	8.0	12.0	25	15	
" "	Disp.					6/1	9/5	2.0	5.0	7.0	25	16	
" "	Packer					6/1	10/15	2.0	7.5	9.5		17	
W " "	F.				29	6/1	9/30	2.0	6.5	8.5	20	18	
Zeigler Mt.	L.O.F.	31	33	28	40	6/16	9/5	1.0	5.0	6.0		19	
Warland Pk.	L.O.F.	6	31	27	58	6/26	9/5	.5	5.0	5.5		20	
Warland R.S.	F	34	32	29	67	7/6	8/31	.0	4.0	4.0		21	8,985.00
Libby R.S.	R. Alt.	35	31	31		4/21	11/15	5.0	10.0	15.0	25	22	
" "	Disp.					6/1	9/5	2.0	5.0	7.0	25	23	
" "	Packer					6/1	10/15	2.0	7.5	9.5		24	
" "	F				25	6/1	9/30	2.0	6.5	8.5	20	25	
Big Swede Mt.	L.O.F.	17	30	30	34	6/16	9/5	1.0	5.0	6.0	10	26	
Blue Mt.	L.O.F.	32	32	30	39	6/21	9/5	.5	5.0	5.5		27	
B.C. Baldy	L.O.F.	12	33	31	48	7/1	8/31		4.5	4.5		28	
Tony Pk.	L.O.F.	19	30	29	51	6/26	9/5	.5	5.0	5.5		29	
Libby R.S.	F.	35	31	31	60	7/6	8/31		4.0	4.0		30	10,600.00
Raven R.S.	R. Alt.	2	26	29		4/21	10/20	5.0	8.0	13.0	25	31	
" "	Disp.					5/16	9/5	3.0	5.0	8.0	25	32	
" "	Packer					6/1	10/15	2.0	7.5	9.5		33	
Fairview	R. Alt.	22	30	27		6/1	9/20	2.0	6.0	8.0	25	34	
W. Fisher Sta.	P.G.	9	26	30		7/1	9/5		5.0	5.0	25	35	
Raven R.S.	F.	2	26	29	30	7/1	9/5		5.0	5.0	20	36	
" "	Cook				31	7/1	8/31		4.5	4.5		37	
Kenelty Mt.	L.O.F.	22	27	29	35	6/16	9/5	1.0	5.0	6.0		38	
Horse Hill	L.O.F.	30	30	26	42	6/16	9/5	1.0	5.0	6.0		39	
Calx Mt.	L.O.F.	10	28	27½	50	6/21	9/5	.5	5.0	5.5		40	
Teeters Pk.	L.O.F.	28	27	30	54	6/26	9/5	.5	5.0	5.5		41	
Horse Mt.	L.O.F.	33	28	30	56	6/26	9/5	.5	5.0	5.5		42	
Raven R.S.	F	2	26	29	70	7/6	8/31		4.0	4.0		43	
W. Fisher Sta.	F	9	26	30	70	7/6	8/31		4.0	4.0		44	14,199.00
								Total normal season cost					47,312.00
								All above cost is fixed					
Emergency Overload	Fire danger ratings above				70								
Rexford R.S.	T. Driv.	15	36	28	73								)
" "	Crew				78								)
Pt. 21 Big Cr.	"	28	35	30	88								)
Rexford R.S.	"	15	36	28	97				Overload Cost				)
" "	"				100				2,848.00			21	) Used only to
Warland R.S.	T. Driv.	34	32	29	72								) extent fire
" "	Crew				84								) danger goes up
" "	"				94								) past 70. Amount
" "	"				100				2,116.00			36	) of cost, one year
Libby R.S.	T. Driv.	35	31	31	72								) with another, is
" "	Crew				79				510.00			42	) uncertain.
Raven R.S.	T. Driv.	2	26	29	73								)
Fairview	Crew	22	30	27	75								)
Wolf Creek	"	35	29	29	85							)	)
Raven R.S.	"	2	26	29	87								)
W. Fisher	"	9	26	30	96				2,732.00			63	)
						Total Overload			8,206.00				

Table 93. Fire control organization plan for the Zone of Influence during the period of constructing the Libby dam

POSITIONS					Fire danger	Fire control occupancy					Travel exp.	No. men	Cost Normal Season
Station	Title	Location				From	To	Pay periods					
		Sec.	Twp.	Rng.				Spring	Summer	Total			
Libby Sup. Office	F. Disp.	3	30	31		4/10	11/15	6.0	10.0	16.0	75	1	
" " "	T. Driv.					5/1	10/30	4.0	15.0	19.0		2	
" " "	ComAsst.					5/15	9/10	3.0	5.0	8.0		3	
" " "	Air Obs.				33	6/16	9/15	1.0	5.5	6.5		4	F.S. $ 3,028.00
" " "	Whs eman.					6/1	9/30	2.0	7.5	9.5		5	Army 6,434.00
" " "	PrevAsst				Dam	1/1	12/31	13.0	13.0	26.0	400	6	9,462.00
Warland R.S.	R. Alt	34	32	29		5/1	10/20	4.5	8.0	12.5	25	7	
" "	Disp					5/1	10/31	4.0	8.5	12.5	25	8	
" "	Packer					6/1	10/15	2.0	7.5	9.5		9	
" "	F					6/1	9/30	2.0	6.5	8.5		10	
" "	P.G.				Dam	5/1	10/31	4.0	15.0	19.0	100	11	
Zeigler Mt.	L.O.F.	31	33	28		5/16	10/15	3.0	8.0	11.0		12	F.S. 8,985.00
Warland Pk.	L.O.F.	6	31	27		6/26	9/5	.5	5.0	5.5		13	Army 7,671.00
Warland R.S.	F	34	32	29		7/6	8/31		4.0	4.0		14	16,656.00
Libby R.S.	R. Alt	35	31	31		4/21	11/15	5.0	10.0	15.0	25	15	
" "	Disp.					5/15	10/31	3.0	8.0	11.0	25	16	
" "	P.Gd.				Dam	5/1	10/31	4.0	8.0	12.0	100	17	
" "	Packer					6/1	10/15	2.0	7.5	9.5		18	
" "	F					6/1	9/30	2.0	6.5	8.5	20	19	
Big Swede	L.O.F.	17	30	30		5/16	10/15	3.0	7.0	10.0	20	20	
Tony Peak	"	19	30	29		5/16	10/15	3.0	7.0	10.0		21	F.S. 10,600.00
Blue Mt.	"	32	32	30		6/21	9/5	.5	5.0	5.5		22	Army 3,745.00
B. C. Balcy	"	12	33	31		7/1	8/31		4.5	4.5		23	14,345.00
Rexford R.S.	R. Alt.	15	36	28		4/21	11/5	5.0	9.0	14.0	25	24	
" "	Disp.					5/16	10/31	3.0	8.0	11.0	25	25	
" "	P.Gd.				Dam	5/1	10/31	4.0	8.0	12.0	100	26	
" "	Packer					6/1	10/15	2.0	7.5	9.5		27	
" "	F				27	6/1	9/30	2.0	6.5	8.5	20	28	
Black Butte	L.O.F.	20	36	27	35	5/16	10/1	3.0	7.0	10.0		29	
Warex Mt.	L.O.F.	6	33	28	44	5/16	10/15	3.0	8.0	11.0		30	
Webb Mt.	L.O.F.	10	35	29		5/16	10/15	3.0	8.0	11.0		31	F.S. 10,500.00
Pinto Pt.	L.O.F.	2	34	30	52	6/26	9/5	.5	5.0	5.5		32	Army 5,450.00
Rexford R.S.	F	15	36	28	70	7/6	8/31		4.0	4.0		33	15,950.00
Raven R.S.													
Fisher River Dist.													
Same as at present except addition of 1L.O.F and													
1 prevention guard, account R.R. construction													F.S. 14,199.00
Present								15.5	74.0	89.5	120	47	Army 4,010.00
Add River View	L.O.F.	25	30	29	44	5/16	10/15	3.0	8.0	11.0		48	18,209.00
Wolf Creek	Prev. Gd.	26	29	29		5/1	10/31	4.0	8.0	12.0	100		
								Total Normal Season Fixed Cost					$74,622.00
									Army	$27,310			
									F.S.	47,312			
Emergency Overload	Same as 1952 - - - - - - - - - - - - - -							$8,206				63	Not fixed. Used only to extent fire danger goes up past danger rating of 70. Amount of cost, one year with another, is uncertain.

Table 94. Fire control organization plan for the Zone of Influence following the construction of Libby dam

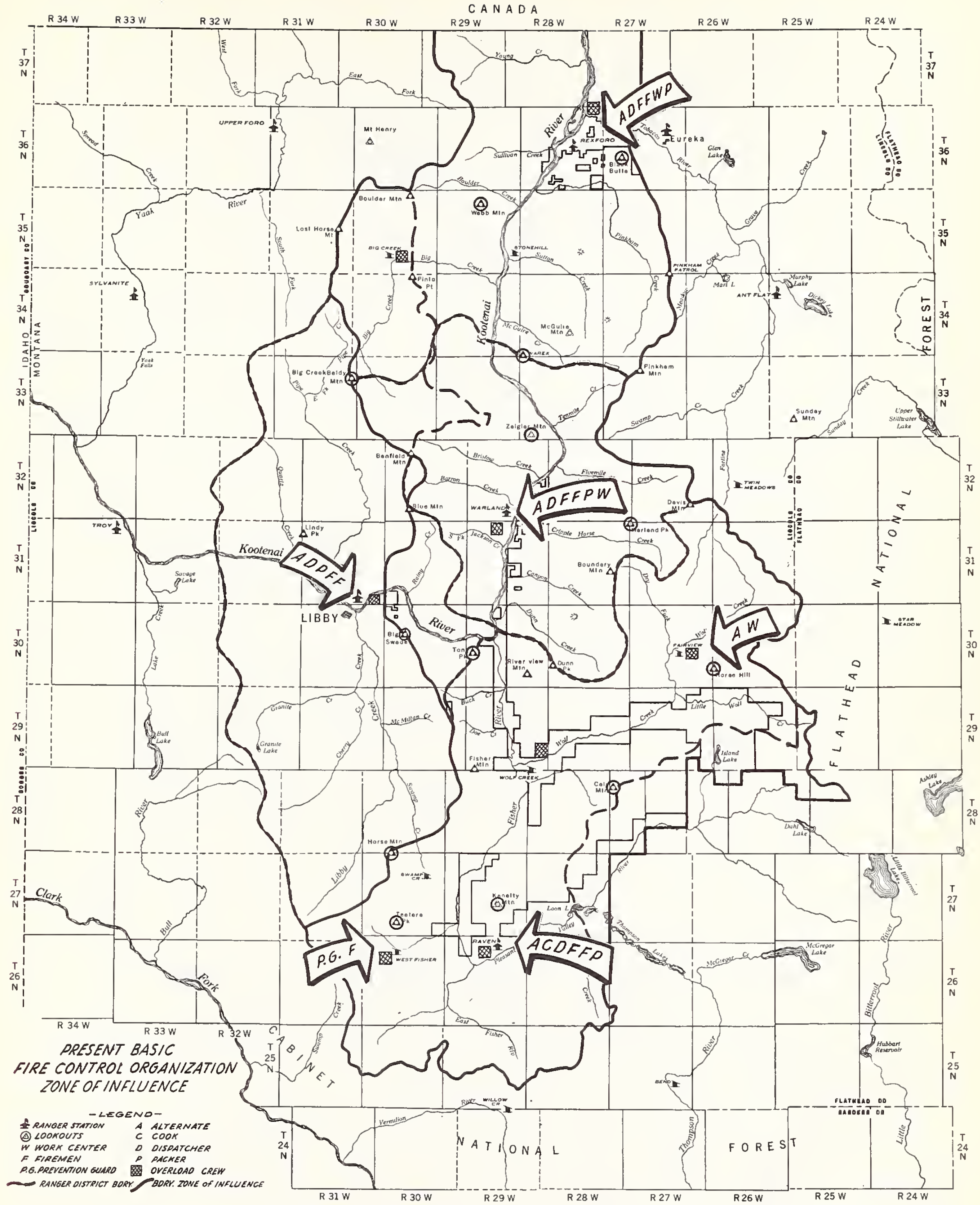
Studies 1 and 2

POSITIONS					Fire danger	Fire control occupancy					Travel exp.	No. men	Cost Normal Season
Station	Title	Location				From	To	Pay periods					
		Sec.	Twp.	Rng.				Spring	Summer	Total			
Libby, Sup. Office	F. Disp	3	30	31		4/10	11/15	6.0	10.0	16.0	75	1	
" " "	T.Driv					6/1	10/15	2.0	7.5	9.5		2	
" " "	CommAsst					5/15	9/10	3.0	5.0	8.0		3	
" " "	A. Obs.				33	6/16	9/15	1.0	5.5	6.5		4	
" " "	Whseman					7/1	9/20		6.0	6.0		5	
					Total cost	$6,056.	Use 50% for Zone						$ 3,065.00
Rexford Dist.	R. Alt.	14	36	27		4/21	10/20	5.0	8.0	13.0	25	6	
Eureka R.S.	Disp.					5/16	9/5	3.0	5.0	8.0	25	7	
" "	F				27	6/1	9/30	2.0	6.5	8.5	20	8	
" "	Whse P					6/1	10/15	2.0	7.5	9.5		9	
Black Butte	L.O.F.	20	36	27	35	6/16	9/5	1.0	5.0	6.0	10	10	
Warex Pk.	"	6	33	28	52	6/26	9/5	.5	5.0	5.5		11	
Eureka R. S.	F.	14	36	27	70	7/6	8/31		4.0	4.0		12	9,934.00
Wolf Creek	R.Alt.	26	29	29		4/21	10/20	5.0	8.0	13.0	25	13	
"	Disp.					5/16	9/5	3.0	5.0	8.0	25	14	
"	Packer					6/1	10/15	2.0	7.5	9.5		15	
"	F.				30	6/16	9/5	1.0	5.0	6.0		16	
"	Cook				31	7/1	8/31		4.5	4.5		17	
Fairview	F	22	30	27	35	6/1	9/20	2.0	6.0	8.0		18	
Horsehill	L.O.F.	30	30	26	42	6/16	9/55	1.0	5.0	6.0		19	
Calx Mt.	L.O.F.	10	28	27½	50	6/21	9/5	.5	5.0	5.5		20	
Fairview	F	22	30	27	70	7/6	8/31		4.0	4.0		21	
Warland Pk.	L.O.F.	6	31	27	58	6/26	9/5	.5	5.0	5.5		22	12,720.00
Warland R.S.	R. Alt.	34	32	29		4/21	10/20	5.0	8.0	13.0	25	23	
" "	Disp.					5/16	9/5	3.0	5.0	8.0	25	24	
" "	Packer					6/1	10/15	2.0	7.5	9.5		25	
" "	F				30	6/1	9/30	2.0	6.5	8.5		26	
" "	Cook				60	7/1	8/31		4.5	4.5		27	
Zeigler Mt.	L.O.F.	31	33	28	40	6/16	9/5	1.0	5.0	6.0		28	
Werland R.S.	F				67	7/6	8/31		4.0	4.0		29	
Webb Mt.	L.O.F.	10	35	29	44	6/21	9/5	.5	5.0	5.5		30	
Young Cr.	F.				30	6/1	10/15	2.0	7.5	9.5		31	12,448.00
Libby R.S.	R. Alt	35	31	31		4/21	11/15	5.0	10.0	15.0	25	32	
" "	Ck.Disp.					6/1	9/5	2.0	5.0	7.0	25	33	
" "	Packer					6/1	10/15	2.0	7.5	9.5		34	
" "	F.				25	6/1	9/30	2.0	6.5	8.5	20	35	
Big Swede L.O.	L.O.F.	17	30	30	34	6/16	9/5	1.0	5.0	6.0	10	36	
Blue Mt.	L.O.F.	32	32	30	39	6/21	9/5	.5	5.0	5.5		37	
B. C. Baldy	L.O.F.	12	33	31	51	7/1	8/31		4.5	4.5		38	
Tony Pk.	L.O.F.	19	30	29	60	6/26	9/5	.5	5.0	5.5		39	
Libby R.S.	F	35	31	31	68	7/6	8/31		4.0	4.0		40	11,211.00
Raven R.S.	R. Alt.	2	26	29		4/21	10/20	5.0	8.0	13.0	25	41	
" "	Disp.					5/16	9/5	3.0	5.0	8.0	25	42	
W. Fisher	Prev.G.	9	26	30		7/1	9/5		5.0	5.0	25	43	
Raven R.S.	F.	2	26	29		7/1	9/5		5.0	5.0	20	44	
Kenelty Mt.	L.O.F.	22	27	29	35	6/16	9/5	1.0	5.0	6.0		45	
Teeters Pk.	L.O.F.	28	27	30	54	6/26	9/5	.5	5.0	5.5		46	
Horse Mt.	L.O.F.	33	28	30	56	6/26	9/5	.5	5.0	5.5		47	
W. Fisher	F.	9	26	30	70	7/6	8/31		4.0	4.0		48	9,510.00
	(Flight expense included)					Total Fixed Normal Season Cost							58,888.00
Emergency Overload.	Fire Danger Ratings above				70								
Eureka	Crew	14	36	27	78				Overload Cost				
"	"				97					$ 1,300		10	)
Wolf Creek	T.Driv.	26	29	29	85								)
" "	Crew				90								)
Warland Cr.	"	30	32	28	84					1,430		21	)
Warland	T.D.	34	32	29	73								)
Warland	Crew				84								)
Big Creek	"	34	30	29	85								) Used only to
" "	"				97					2,080		37	) extent fire danger
Libby R.S.	T.Driv.	35	31	31	72								) rating goes above
" "	Crew				86					910		43	) 70. Amount of
Raven R.S.	Crew	2	26	29	87								) cost, year to
" "	T.Driv.				73								) year is
W. Fisher	Crew	9	26	30	96					1,430		54	) uncertain.
								Total Overload		7,150			

Table 95. Fire control organization plan for the Zone of Influence following the construction of Libby dam

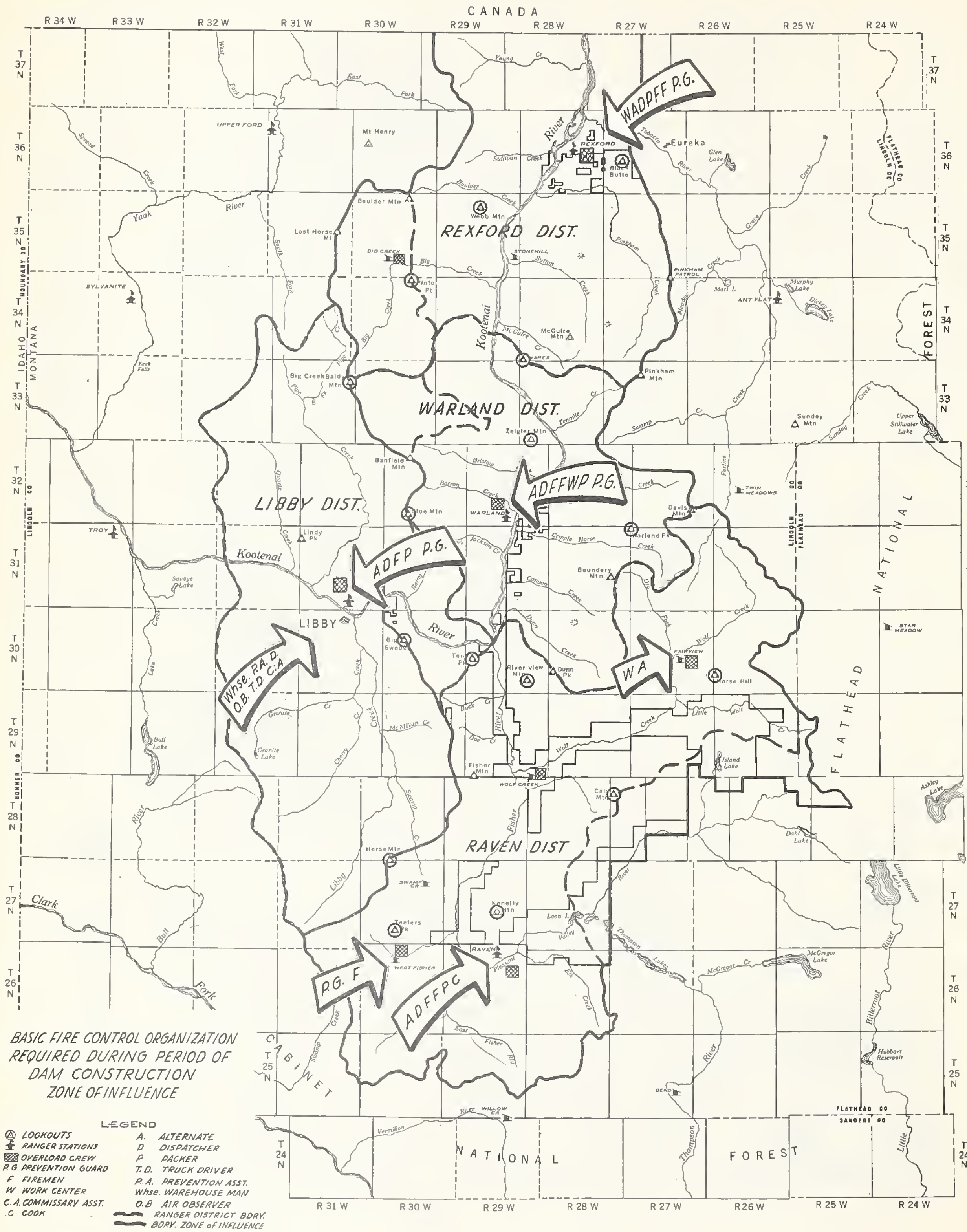
Study 3

POSITIONS					Fire danger	Fire control occupancy					Travel exp.	No. men	Cost Normal Season
Station	Title	Location				From	To	Pay periods					
		Sec.	Twp.	Rng.				Spring	Summer	Total			
Libby Sup. Office		Same as under Study 1										5	$ 3,065.00
Flying time								20 hrs	155 hrs	175 hrs	Cost distributed among districts		
Eureka	R. Alt.	14	36	27		4/21	11/5	5.0	9.0	14.0	25	6	
"	Disp.					5/16	9/5	3.0	5.0	8.0	25	7	
"	Packer					6/1	10/15	2.0	7.5	9.5		8	
"	F.					6/1	10/15	2.0	7.5	9.5	20	9	
Black Butte	L.O.F.	20	36	27		6/16	9/5	1.0	5.0	6.0		10	
Webb Mt.	L.O.F.	10	35	29		6/21	9/5	.5	5.0	5.5		11	
Warex Pk.	L.O.F.	6	33	28		6/26	8/31	.5	5.0	5.5		12	
Eureka	F	14	36	27	70	7/6	8/31		4.0	4.0		13	11,292.00
Libby R.S.	R. Alt.	35	31	31		4/21	11/15	5.0	10.0	15.0	25	14	
"	Disp.					6/1	9/5	2.0	5.0	7.0	25	15	
"	Packer					6/1	10/15	2.0	7.5	9.5		16	
" "	F.					6/1	9/30	2.0	6.5	8.5	20	17	
Big Swede	L.O.F.	17	30	30		6/16	9/5	1.0	5.0	6.0	10	18	
Blue Mt.	L.O.F.	32	32	30		6/21	9/5	.5	5.0	5.5		19	
Zeigler	L.O.F.	31	33	28		6/16	9/5	.5	5.0	5.5		20	
B. C. Baldy	L.O.F.	12	33	31		7/1	8/31		4.0	4.0		21	
Others in this district are not chargeable to Zone of Influence													11,121.00
Wolf Creek	R. Alt.	26	29	29		5/6	10/20	4.0	8.0	12.0	25	22	
" "	Disp.					6/1	9/5	2.0	5.0	7.0	25	23	
" "	Packer					6/1	10/15	2.0	7.5	9.5		24	
" "	F					6/1	9/30	2.0	6.5	8.5	20	25	
" "	Cook					7/1	8/31		4.5	4.5		26	
Horsehill	L.O.F.	30	30	26		6/16	9/5	1.0	5.0	6.0		27	
Calx Mt.	L.O.F.	10	28	27		6/21	9/5	.5	5.0	5.5		28	
Tony Mt.	L.O.F.	19	30	29		6/26	9/5	.5	5.0	5.5		29	
Warland Pk.	L.O.F.	6	31	27		6/26	9/5	.5	5.0	5.5		30	
Fairview	F	22	30	27		7/6	8/31		4.0	4.0		31	12,378.00
Raven R.S.	R. Alt.	2	26	29		4/21	10/20	5.0	8.0	13.0	25	32	
" "	Disp.					5/16	9/5	3.0	5.0	8.0	25	33	
" "	Packer					6/1	10/15	2.0	7.5	9.5		34	
W. Fisher	P. Guard	9	26	30		7/1	9/15		5.0	5.0	25	35	
Raven	F	2	26	29		7/1	9/5		5.0	5.0	20	36	
"	Cook					7/1	8/31		4.5	4.5		37	
Kenelty Mt.	L.O.F.	22	27	29		6/16	9/5	1.0	5.0	6.0		38	
Teeters Mt.	L.O.F.	28	27	30		6/26	9/5	.5	5.0	5.5		39	
Horse Mt.	L.O.F.	33	28	30		6/26	9/5	.5	5.0	5.5		40	
W. Fisher	F	9	26	30	70	7/6	8/31		4.0	4.0		41	12,041.00
								Total Fixed Normal Season Cost					$49,897.00
Emergency Overload	Fire Danger ratings above				70								
Eureka	T. Driv.	14	36	27	73				Overload Cost				
"	Crew				78								
Pt. 21 Big Cr.	"	28	35	30	88								
Webb Cr. Crossing	"	12	35	29	96					2,080		16)	
Libby R.S.	T. Driv.	35	31	31	72							)	
Bristow Cr.	Crew				79							)	
Libby	"				86					1,430		27)	
Wolf Creek	T. Driv.				72							)	
Fairview	Crew				75							)	Used only in
Warland Work Center	"				82							)	times when fire
Wolf Creek	"				85					2,080		43)	danger rating
Raven R.S.	T.D.	2	26	29	73							)	goes above 70.
" "	Crew				85							)	
W. Fisher	"	9	26	30	90					1,430		54)	
							Total	Overload		$7,020			



CANADA
PRESENT BASIC
FIRE CONTROL ORGANIZATION
ZONE OF INFLUENCE
— LEGEND —
RANGER STATION
LOOKOUTS
W WORK CENTER
F FIREMEN
P.G. PREVENTION GUARD
A ALTERNATE
C COOK
D DISPATCHER
P PACKER
OVERLOAD CREW
RANGER DISTRICT BDRY.
BDRY. ZONE of INFLUENCE
ADFFWP
ADFFPW
ADPFF
AW
P.G. F
ACGDFFP
LIBBY
Eureka
TROY
REXFORD
CABINET NATIONAL FOREST
FLATHEAD NATIONAL FOREST

Figure 55



CANADA
REXFORD DIST.
WARLAND DIST.
LIBBY DIST.
RAVEN DIST
WADPFF P.G.
ADFFWP P.G.
ADFP P.G.
Whse. P.A.D. O.B. T.D. C.A.
W A
P.G. F
ADFFPC
NATIONAL FOREST
FLATHEAD NATIONAL
CABINET
BASIC FIRE CONTROL ORGANIZATION REQUIRED DURING PERIOD OF DAM CONSTRUCTION ZONE OF INFLUENCE
LEGEND
LOOKOUTS
RANGER STATIONS
OVERLOAD CREW
P.G. PREVENTION GUARD
F FIREMEN
W WORK CENTER
C.A. COMMISSARY ASST.
C COOK
A. ALTERNATE
D DISPATCHER
P PACKER
T.D. TRUCK DRIVER
P.A. PREVENTION ASST.
Whse. WAREHOUSE MAN
O.B AIR OBSERVER
RANGER DISTRICT BDRY.
BDRY. ZONE of INFLUENCE

Figure 56

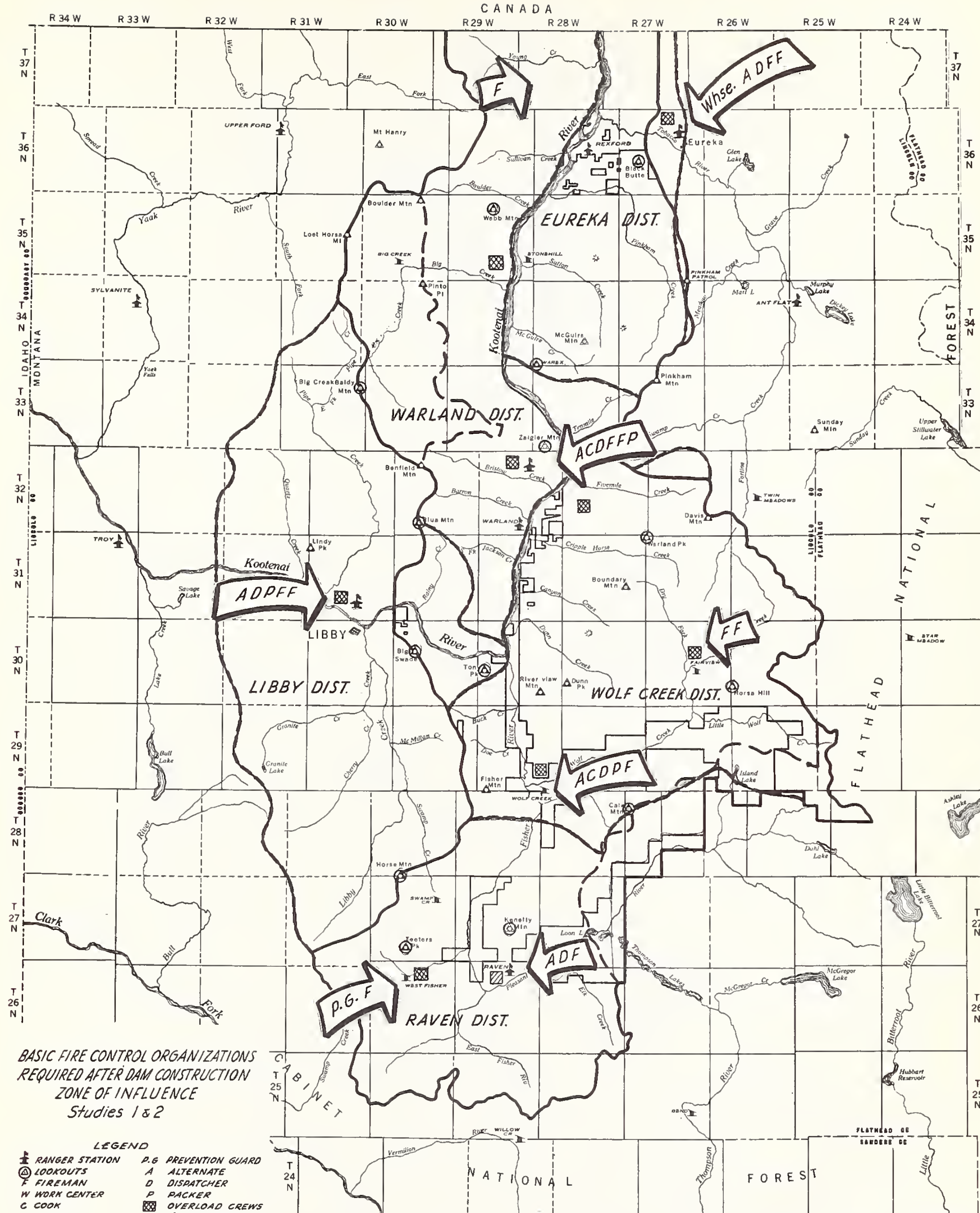

CANADA
EUREKA DIST.
WARLAND DIST.
LIBBY DIST.
WOLF CREEK DIST.
RAVEN DIST.
Whse. ADFF
F
ACDFFP
ADPFF
FF
ACDPF
ADF
P.G. F
LIBBY
Eureka
REXFORD
Kootenai
River
FLATHEAD NATIONAL FOREST
CABINET NATIONAL FOREST
IDAHO
MONTANA
BASIC FIRE CONTROL ORGANIZATIONS
REQUIRED AFTER DAM CONSTRUCTION
ZONE OF INFLUENCE
Studies 1 & 2
LEGEND
RANGER STATION
LOOKOUTS
F FIREMAN
W WORK CENTER
C COOK
P.G PREVENTION GUARD
A ALTERNATE
D DISPATCHER
P PACKER
OVERLOAD CREWS
RANGER DISTRICT BDRY.
BDRY. ZONE of INFLUENCE

Figure 57

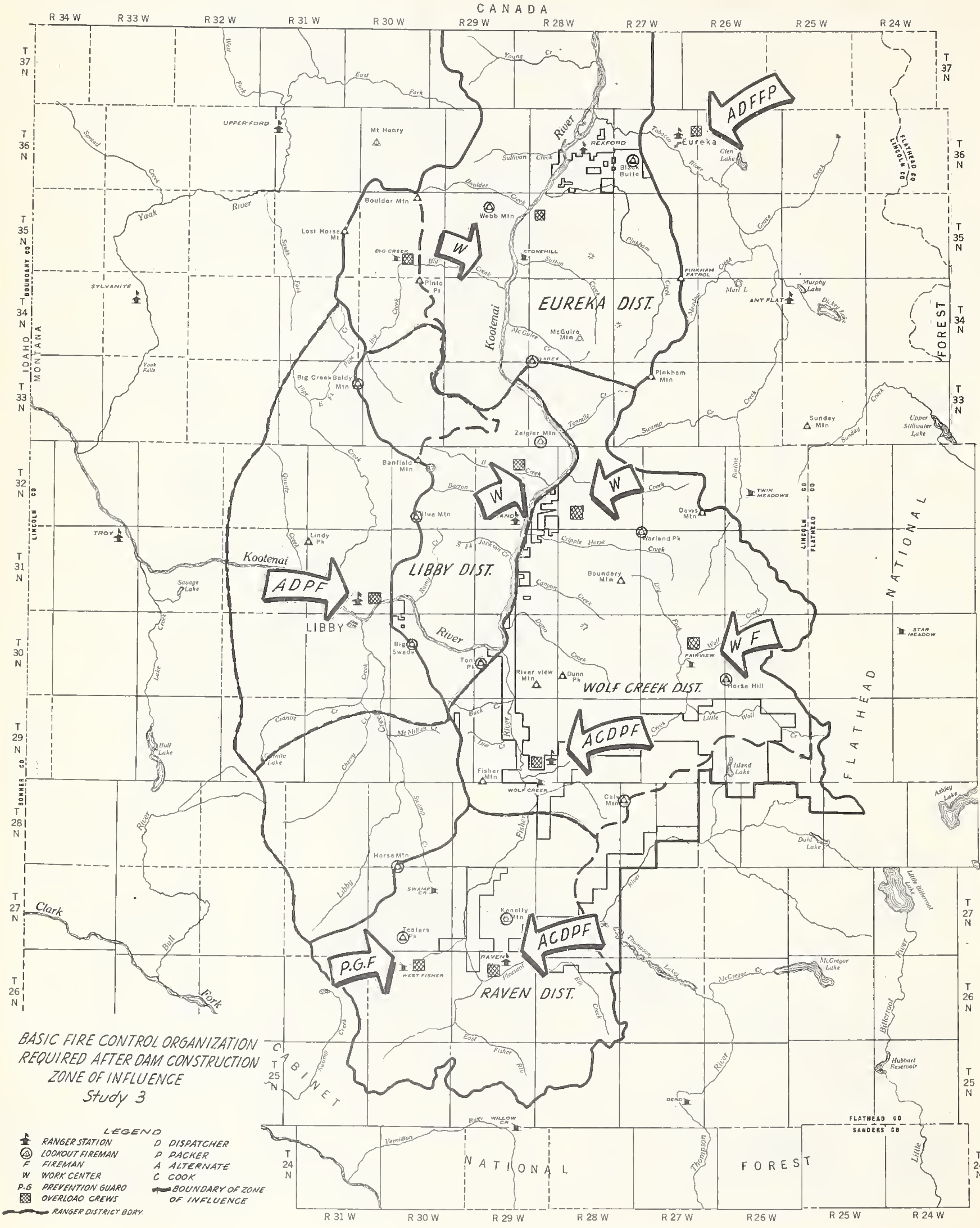

CANADA
BASIC FIRE CONTROL ORGANIZATION
REQUIRED AFTER DAM CONSTRUCTION
ZONE OF INFLUENCE
Study 3
LEGEND
RANGER STATION
LOOKOUT FIREMAN
F FIREMAN
W WORK CENTER
P.G PREVENTION GUARD
OVERLOAD CREWS
RANGER DISTRICT BDRY.
D DISPATCHER
P PACKER
A ALTERNATE
C COOK
BOUNDARY OF ZONE OF INFLUENCE
EUREKA DIST.
LIBBY DIST.
WOLF CREEK DIST.
RAVEN DIST.
ADFFP
ADPF
ACDPF
ACDPF
P.G.F
W F
W
W
W
LIBBY
Eureka
CABINET
NATIONAL FOREST
FLATHEAD NATIONAL FOREST

Figure 58.

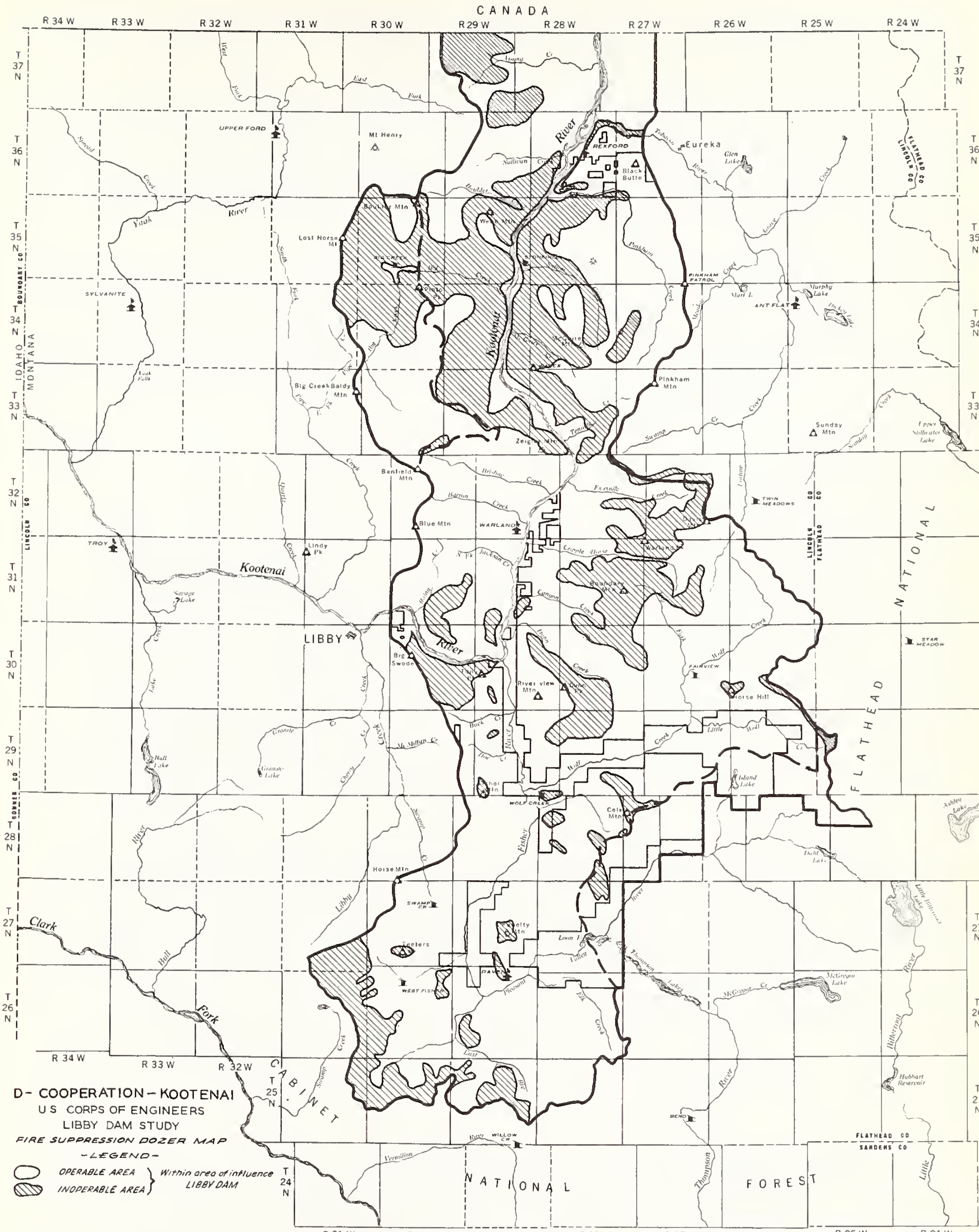

CANADA
D- COOPERATION - KOOTENAI
U S CORPS OF ENGINEERS
LIBBY DAM STUDY
FIRE SUPPRESSION DOZER MAP
-LEGEND-
OPERABLE AREA
INOPERABLE AREA
Within area of influence LIBBY DAM
LIBBY
Eureka
Kootenai
River
CABINET
NATIONAL FOREST
FLATHEAD

Figure 59

Forest had relatively few large fires between 1931 and 1950. This was possible partly because of a very good road system. The needs for roads would not be eliminated by the use of smokejumpers. Smokejumpers are very valuable where it is safe to use them. They can be and are used where the area is suitable for jumping, but that is not everywhere. Rocky ground, very steep areas, areas having many snags or old spike-topped trees are unsuitable. Ordinarily, if wind velocity is over 15 miles an hour, jumping is unsafe. Night-time smokejumping is not feasible. Fires often occur at night and are attacked before morning by ground forces where roads are available.

Table 96 shows the average additional annual costs of suppressing large fires which escaped initial action from 1931 to 1950. It is estimated that these costs would have been slightly higher with the Studies 1 and 2 transportation systems. If the road system had been as proposed in Study 2, the suppression costs probably would have been slightly less than was actually the case.

Big game management

Following is an analysis of the impact of a dam at River Mile 204.9 upon the big game resource of the Kootenai National Forest, and the Forest Service recommendation for alleviating the adverse effects of this impact upon the game population. The game management responsibility is shared three ways: by the Forest Service as the land-managing agency, the Montana Fish and Game Commission operating under State fish and game laws, and the Federal Fish and Wildlife Service. The latter two agencies have a major part of the responsibility for game management, game law enforcement, and game management research. For that reason, any program finally adopted should rest not just on the recommendation of the Forest Service, but upon the consensus of all three agencies.

Although the cost of measures designed to alleviate game problems resulting from the flooding of certain lands have been estimated here, they are not included in the overall evaluations of Studies 1, 2, and 3, as these costs in no way affect the desirability of the different transportation plans. The game problem and the task of solving it would be the same in any case.

If the Libby dam is built at River Mile 204.9 to an elevation of 2459 feet it will inundate 22,700 acres of winter game range, or about 23 percent of the total area of such land in the Zone of Influence (table 97).

Flooding that acreage would, however, cause only a 20-percent reduction of the winter range carrying capacity because some of these lands within the proposed flowage are not usable during winters of deep snows. Following is the situation by three main subdivisions of the Zone of Influence.

Table 96. Comparison of actual costs of fighting large fires, (1931-1950) with probable costs, Zone of Influence

Studies 1, 2, and 3

Ranger district	Study number	Labor	Tanker	Jumper	Dozer	Air	Truck	Pack stock	Total
		Dollars							
Fisher River	Actual	9,537	33	315	319	977	176	54	11,411
	1 and 2	9,537	33	315	350	977	220	54	11,486
	3	9,537	33	315	350	977	175	54	11,441
Libby	Actual	8,683	120	735	270	386	210	66	10,470
	1 and 2	9,551	120	735	320	425	250	66	11,467
	3	8,249	120	735	250	386	200	66	10,006
Warland	Actual	2,052	31	149	132	60	36	4	2,464
	1 and 2	2,257	50	179	200	75	45	4	2,810
	3	2,000	31	149	132	50	30	4	2,396
Rexford	Actual	4,327	70	306	179	630	343	56	5,911
	1 and 2	4,750	100	350	215	650	450	56	6,571
	3	4,327	70	306	150	600	300	56	5,809
Total 1/	Actual	24,599	254	1505	900	2053	765	180	30,256
	1 and 2	26,095	303	1579	1805	2127	965	180	32,334
	3	24,113	254	1505	882	2013	705	180	29,652

1/In addition, under Studies 1 and 2, there is need of a boat on the lake, capable of carrying 6 men and gear, for getting at fires of flash fuel (high-high and medium-high), in spots not readily accessible from the roads proposed in these studies. The annual cost of such a boat is estimated at $2000 a year. Thus, the average annual suppression costs under Studies 1 and 2 amount to $34,334, and under Study 3 to $29,652, as compared to $30,256, a 20-year average, under Study 0. The boat use planned here under Studies 1 and 2 is in addition to any such facilities which may be needed for the presuppression job. A boat used in suppression work must be ready and available at all times, and may not be used for other purposes during burning season.

Table 97. Winter range, Zone of Influence

Area	Present approximate acreage	Range acreage to be inundated	Acreage remaining
	Acres		
Fisher-Wolf Creek	40,000	2,200	37,800
Gateway-Jennings	35,000	15,000	20,000
Libby	25,000	5,500	19,500
Total	100,000	22,700	77,300

Fisher River-Wolf Creek area. Winter forage over much of this area is of the browse type such as serviceberry, chokecherry, maple, snowbush, kinnikinnick, Oregon-grape, dogwood, mock orange, alder, birch, willow, snowberry, buffaloberry, gooseberry, and wild rose. Alder and willow predominate along the river bottom. On the lower Fisher River the southerly slopes also have considerable grass, little of which is used by deer. On the whole the winter browse of this locality is in poor condition. The best species have been eaten almost to the point of killing. Much damage is done during the severe winters when the deer concentrate on small areas.

Snow depths in this locality vary greatly. In the upper Fisher River they may reach 3 or 4 feet along the bottoms, tapering off up the slopes, particularly those with a southerly aspect. In the lower Fisher River the snow depths range from 12 to 20 inches in the bottoms to 2 to 6 inches up the sidehills. Temperatures likewise vary widely. The minimums, for example, range from a November figure of 20 to 22 degrees above zero to 30 degrees below in January and February. However, the thermometer seldom drops below minus 10 degrees.

About 40,000 acres within this area are classed as winter range, which supports about 7000 whitetail deer, 600 blacktail deer, 150 elk, and 20 moose (spot counts made by State of Montana). The flowage would inundate about 2200 acres. As logging progresses in this locality, some additional areas outside the flowage and suitable for winter range so far as snow depth is concerned, would likely become better stocked with browse, thus helping relieve the overcrowding.

The only management measures which might be undertaken to compensate for the loss of winter range are fencing and restoration of shrub growth through planting. The loss of 2200 acres of rather lightly used winter range could be compensated by increasing the production on 4000 acres of open hillsides by about 100 percent. The entire area east of the Lower Fisher River from the ridge north of Cody Creek upstream to Cow Creek is suitable for such rehabilitation. Here there are patches of from 40 to 400 acres which have been heavily overbrowsed, some of which are nearly devoid of live shrubs. These patches could be contoured with a light bulldozer and planted with browse seedlings two to three years old. The Forest Service regional nursery is presently growing five species of browse shrubs, some or all of which should be suitable for this locality. Such planted areas would have to be enclosed for at least 10 years with deer-proof fences 84 inches high. With such protection, the areas would be thoroughly rehabilitated, but the cost would be high, about $30 an acre for fencing, $25 an acre for planting, $5 an acre for fence maintenance over 10 years, and $2 an acre for removing and rolling up the fence, a total of about $62 an acre. To so treat 4000 acres would cost $248,000. This effort would accomplish little unless deer numbers were kept to a level which the winter range in the area could support without overuse. Furthermore, subsequent rotation grazing would be necessary to prevent the deer from overloading and wrecking the rehabilitated areas. This, likewise, would require fencing.

Rotation fencing on a large scale could be done without planting. This would also be expensive and would have to be accompanied by a sufficient annual kill to keep big game numbers at a reasonable level. Either solution to the big game problem would involve intensive management and is probably not justified at this time because the hunting pressure is still light. It is understood that the State Fish and Game Commission and the Fish and Wildlife Service are studying this problem and will come up with concrete recommendations.

Gateway-Jennings area. The forage on the winter range portion of this area is practically all of the browse type. The same shrubs occur here as in the Fisher River-Wolf Creek area. The condition of the range is fairly good, but there is some overbrowsing in the Warland vicinity. Logging has been and is being carried on.

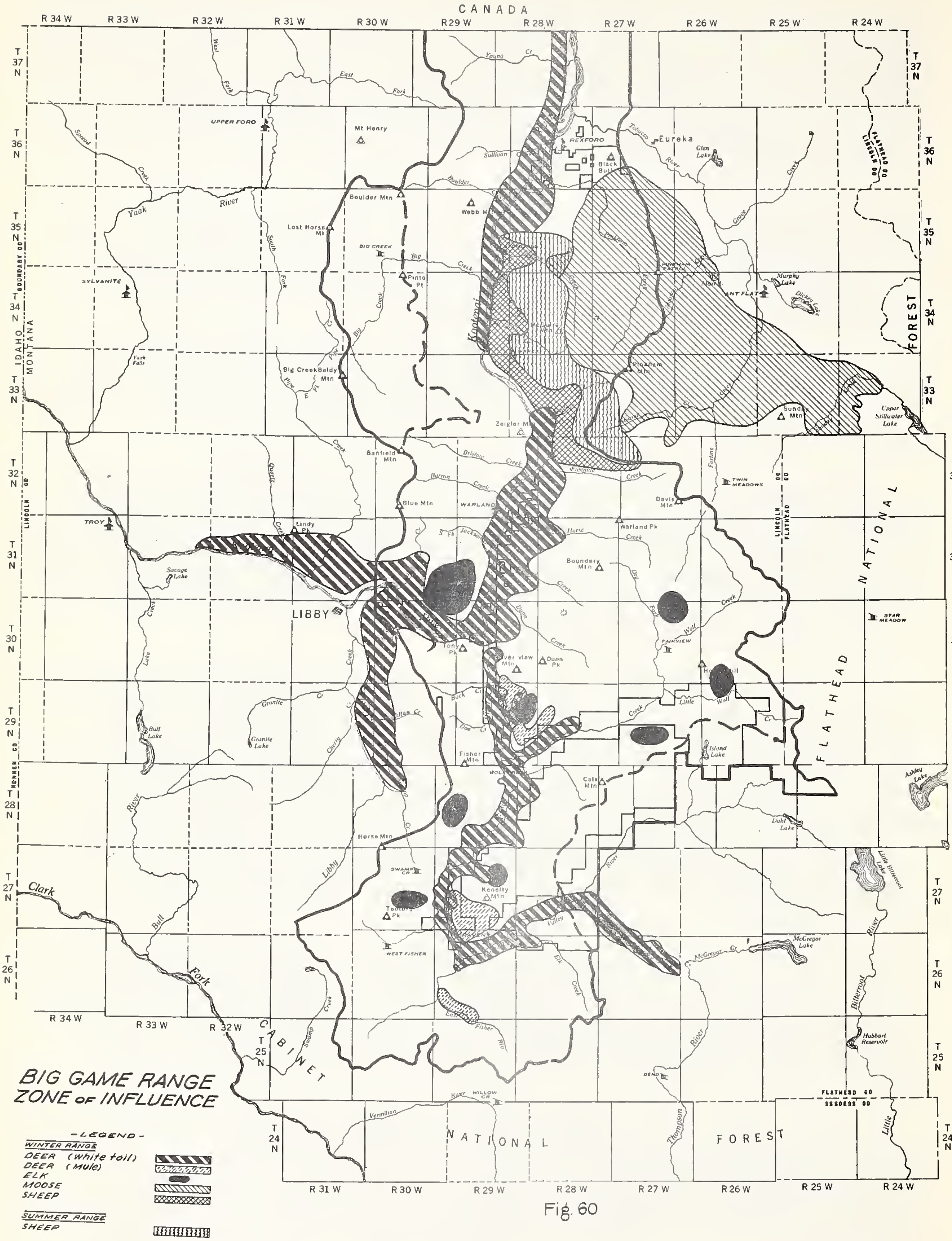
Snow depth, which is less of a problem than in the Fisher River-Wolf Creek area, ranges from 6 inches to 2 feet. Temperatures have dropped as low as 30 degrees below zero, but the thermometer seldom falls below minus 10 degrees.

There are about 35,000 acres of winter range in the Zone of Influence between the Canadian line and Jennings. Figure 60 shows the location of this range. It supports about 2000 blacktail deer, 1200 whitetail deer, a few elk, and about 20 moose. The so-called Ural-Tweed bighorn sheep herd of about 200 animals ranges from Five Mile Creek northerly to Bear Trap Mountain. Their winter range of 24,000 acres would be little affected by the reservoir.

The deer winter range would be reduced 15,000 acres by the inundation. However, it appears likely that the animals would extend their winter grazing into another 10,000 acres lying higher on the slopes. This area, not presently utilized to any extent, is suitable for winter range. Thus, the present winter big game range of 35,000 acres might suffer a net reduction to 30,000 acres with about two-thirds the present capacity. Domestic livestock grazing in this area would decrease with the inundation of the valley bottom farms. This would reduce the competition for summer range and perhaps reduce the winter range pressures somewhat.

Beyond holding the numbers of big game animals to the level which could be supported by the available browse, there is apparently little which could or should be done in a management way to compensate for the loss of winter game range in this area. The State Fish and Game Commission and the Fish and Wildlife services may have recommendations on that score.

Libby area. This area extends downriver from Jennings to several miles west of Libby and into the Libby Creek drainage. The browse species enumerated for the Fisher River-Wolf Creek area also occur here. In addition, there is considerable bitter brush on open grassy hills on the north side of the Kootenai River from Rainy Creek to Jennings. This area is locally known as the Horse Range. It provides much of the winter food for the deer in the Libby area.



CANADA
BIG GAME RANGE
ZONE OF INFLUENCE
- LEGEND -
WINTER RANGE
DEER (white tail)
DEER (Mule)
ELK
MOOSE
SHEEP
SUMMER RANGE
SHEEP
LIBBY
Eureka
REXFORD
TROY
CABINET
NATIONAL FOREST
FLATHEAD NATIONAL FOREST
IDAHO
MONTANA

Fig. 60

The winter range in the Libby area is good--much better than in either of the other two areas--as it is close to a larger community. The hunting pressures here are sufficient to keep the herds to a size that the winter range can support.

Snow depths range from 6 inches in the Horse Range to 18 inches south of Libby. These are averages. Sometimes there is much more snow for short periods. Temperatures drop to 30 degrees below zero, but seldom below a minus 10 degrees. The average winter temperature is 10 degrees above zero at night and about 32 degrees above zero during the daylight hours.

There are about 25,000 acres of winter range in this area. It supports about 600 whitetail deer, 700 blacktail deer, and a few elk. As the bottom lands are fairly heavily settled and the town of Libby lies in the center of the area, the lands in that area that might support deer in the winter have not attracted many animals. Consequently, the reservoir would not change winter range conditions here.

Fisheries management

The Kootenai River is not presently a good trout stream. Two important environmental factors account for this. The stream is too cold and it carries too much silt. This situation has always been a problem in the river. The fine glacial silt is deposited over the bottom and seriously inhibits the growth of algae and zooplankton which are the foundation of the trout's food chain. And less food means less trout.

The best water temperature for trout is 63 degrees Fahrenheit. Such data as are available indicate that the Kootenai River seldom, if ever, gets this warm--even in the summer. Following are some temperatures taken in recent years:

Date	Surface water temperature Degrees Fahrenheit
1949	
March 14	34
November 5	38
December 7	32
1950	
January 22	32
March 13	32.5
April 19	44
May 4	42
May 19	44
1951	
April 24	42
September 20	55
October 17	39
1952	
April 11	43
May 6	45
May 27	51
July 9	58

It is to be expected that the Libby dam reservoir would act as a desilting basin. How effective it would be in that respect is not known. Glacial silt is very fine and is carried in near colloidal suspension. Furthermore, there may be some muddying of the reservoir from slides resulting from drawdown. However, the overall effect of the dam should be clearer water both in the reservoir and downstreams. The clearer water should, of course, improve the production of algae and zooplankton below the dam. How much of an increase would occur in the reservoir itself is questionable because that is where the silt would be dropped. Moreover, the large drawdown (130 feet) would not permit continuity of food production on that portion of the reservoir bottom above the minimum pool level.

Surface temperature of the reservoir in the warmer months would be raised considerably. This might not help fish culture in the reservoir as the bottom levels would remain cold. Likewise, it would not improve the downstream trout production unless the water were discharged from the upper levels. Customarily, penstocks are designed to take water from the lower levels. If that were the case here, the Libby dam might even lower the temperature and thus make downstream conditions less favorable for trout.

We are unable to evaluate the feasibility of an intake to the turbines which would draw water always from the upper levels. Such modification of the dam design might cost more than could be justified. On the other hand, it is important that the Corps of Engineers give serious attention to modifications of the dam design which would produce outside benefits such as this.

The operating policy of the dam could also affect fish production and fishing. Both trout and trout fishing would benefit from a steady flow of water. Seasonal differences must be expected, but wide daily fluctuation of water discharge endangers the fisherman and creates an unstable habitat for the trout. It is reported that several sportsmen have drowned in the Klamath River below the Copro Dam in northern California following a sudden rise in water levels of 18 to 24 inches.

The possibilities of a pulpmill somewhere downstream must be considered. If one is built, the flow of the river should not be allowed to drop below the point where it adequately dilutes the mill waste to avoid serious pollution. Experts in the field of water pollution have indicated that there should be a minimum flow of 1200 cubic feet a second to handle the effluents of a 400-ton sulfite pulpmill. A considerably larger flow would be required for a calcium sulfite mill of the same size. The Corps of Engineers estimates that the flow from the dam would be held above 2400 cubic feet a second. If such a minimum were adhered to, and the industrial effluents were properly handled, there could be in the Troy-Libby area a substantial industrial development of the sort requiring streams for waste disposal, without risk of pollution sufficient to endanger health, fish life, or other water uses.

To summarize, it is recommended:

1. Drawdown discharge and the water supply to the turbines be taken from the top layers of the reservoir from the middle of April until the middle of October, if that is feasible.

2. The streamflow be regulated to avoid the sudden discharge of large volumes of water.

3. The streamflow be regulated to assure a minimum discharge of at least 2400 cubic feet per second.

4. The Forest Service collaborate with the Fish and Wildlife Service and the Montana Fish and Game Commission in such fisheries studies as those agencies may conduct in connection with this problem.

Recreational development

Past recreational use of the area in the vicinity of the proposed Libby dam gives no clue as to the amount and kinds of use that should be expected on the large lake which would be created by the dam. Conditions would be very different. Attractions and recreational opportunities would be multiplied many times. The physical characteristics of the water body would be favorable and encouraging to recreational uses. It should have value and appeal for aquatic forms of recreation, particularly boating, to a greater degree than many other lakes in this part of the Northwest. While its length of about 107 miles, extending 42 miles into Canada, would be sufficient for extensive boat trips, its width would not be so much as to lose for boaters the intimate views of the shores and backgrounds which would be of unending interest. The narrowness of the reservoir and the windings and protection of the enclosing canyon from sweeping wind currents would give a water surface more than ordinarily free of waves and other natural dangers for small boats. The shorelines would be forested and scenically attractive when the water level is at or near the maximum which would be during the period June 15 to October 31. Wherever the ground is suitable, the settings would be nice for many kinds of recreational use.

The reservoir would be close to and served directly by transcontinental Highway 2. This highway, as all of its sections near completion, is receiving tremendous increases in travel. Together with State Highway 37, it would make the area easily accessible and could be expected to bring many recreationists to it. Nearby Glacier Park will be a significant influence on this.

While it is difficult at this state to foresee the eventual recreational use of the lake and bordering lands, expressed in number of recreationists annually, the possibilities indicate the advisability of caution not to underestimate the potential. We have the benefit of experience of projects of similar kind at the Boulder and Grand Coulee dams. Table 98 shows recreational use at those places and potential use estimates for the Hungry Horse reservoir.

Table 98. Annual recreational use of certain major reservoirs

Name of water development project	Length	Size	Users of area before construction	Users 1 to 2 years after completion	Users 5 years after completion	Users 15 years after completion	Estimated ultimate use
	Miles	Acres	- - - - - - - - - -	- - - - - Number	- - - - -	- - - - -	- - - - -
Boulder (Lake Mead)	120	1,951,928	-	225,000 (1938)	800,000 (1941)	1,465,000 (1949)	-
Coulee (Lake Roosevelt)	350	98,500	-	150,000 (1936)	325,000 (1941)	365,000 (1949)	-
Hungry Horse	35	24,000	7,400	-	1/ 25,000	-	2/ 140,000

1/Estimated, exclusive of sightseers. 2/Including sightseers visiting only the dam.

Judging from these records from the Boulder and Coulee projects, it would seem reasonable to expect that within 15 years after completion of the dam there would be up to 200,000 visitors annually to the area for recreation, and perhaps ultimately as many as a half million. With 200,000 visitors annually, the average maximum daily traffic would probably be 1500. This would include people coming for picnicking, camping, boating, fishing, swimming, and other active or restive recreation. The area and developed capacity that should be used for recreation has been estimated on the basis of this volume of use.

Problems of use for recreation. The better lands presently available for recreational facilities in the Zone of Influence would be flooded by the reservoir. The more suitable areas after the dam would be very much smaller while the demand and need for recreational areas would be greatly increased.

Inasmuch as the lake would be used for transporting large quantities of timber during the summer and fall, there necessarily would have to be landing grounds and facilities for putting timber into the water, as well as sites for logging camps. Room for rather extensive developments would be needed near the lower end of the reservoir for removing these same logs from the water and transfering them to trucks. The placing of these facilities would be pretty well dictated by the location of the timber and the topography.

Such studies as have been made indicate, fortunately, that the best locations for the industrial facilities are in places where there would be no conflict with recreational needs. From the transportation studies and the recreational examination so far made, it appears that in only two of the places so far inventoried and recognized as having special

values for recreation is it probable that there might be some competition between recreational and nonrecreational needs for available space. One of these is at the lower end of the reservoir in the vicinity of the dam. The other is at Bristow Creek about 20 miles up the reservoir. At both places permanent major logging facilities would be needed. Since there are sizable areas of usable ground at both sites, conflict undoubtedly could be avoided by thoughtful planning.

Forms of recreational use for which sites and ground would be needed would include (a) public boat landings, with attendant boating services; (b) commercial boat rentals, livery, passenger and cargo transportation; (c) public use sites developed for launching and removing from the water small privately-owned boats, either on a commercial service basis or by the owners themselves; (d) public campgrounds and picnic areas; (e) public service resorts with cabins or other lodging, meals, supplies, etc., as may be needed for the convenience and accommodation of recreationists; (f) organization campsites; and (g) clubsites and summer homes, if and where there are areas which could be allocated to these purposes after the public and utility needs are provided for.

The best locations for sites for these several purposes are determined by a combination of factors: (a) The suitability and adequacy of the area for the kind of development or use needed. (b) Availability of water for domestic use. This factor gives special value to any tracts of usable ground near good sidestreams. Much of the land adjacent to the lakeshore between the streams is without surface evidence of water source for domestic uses. Storage of water in the reservoir to the project boundary elevation undoubtedly would create water tables in adjacent grounds, and if tapped by wells might be a satisfactory source for some use tracts otherwise without water supply. (c) The minimum of unfavorable shore conditions and effect on access to the water frontage which might result from fluctuation of lake level.

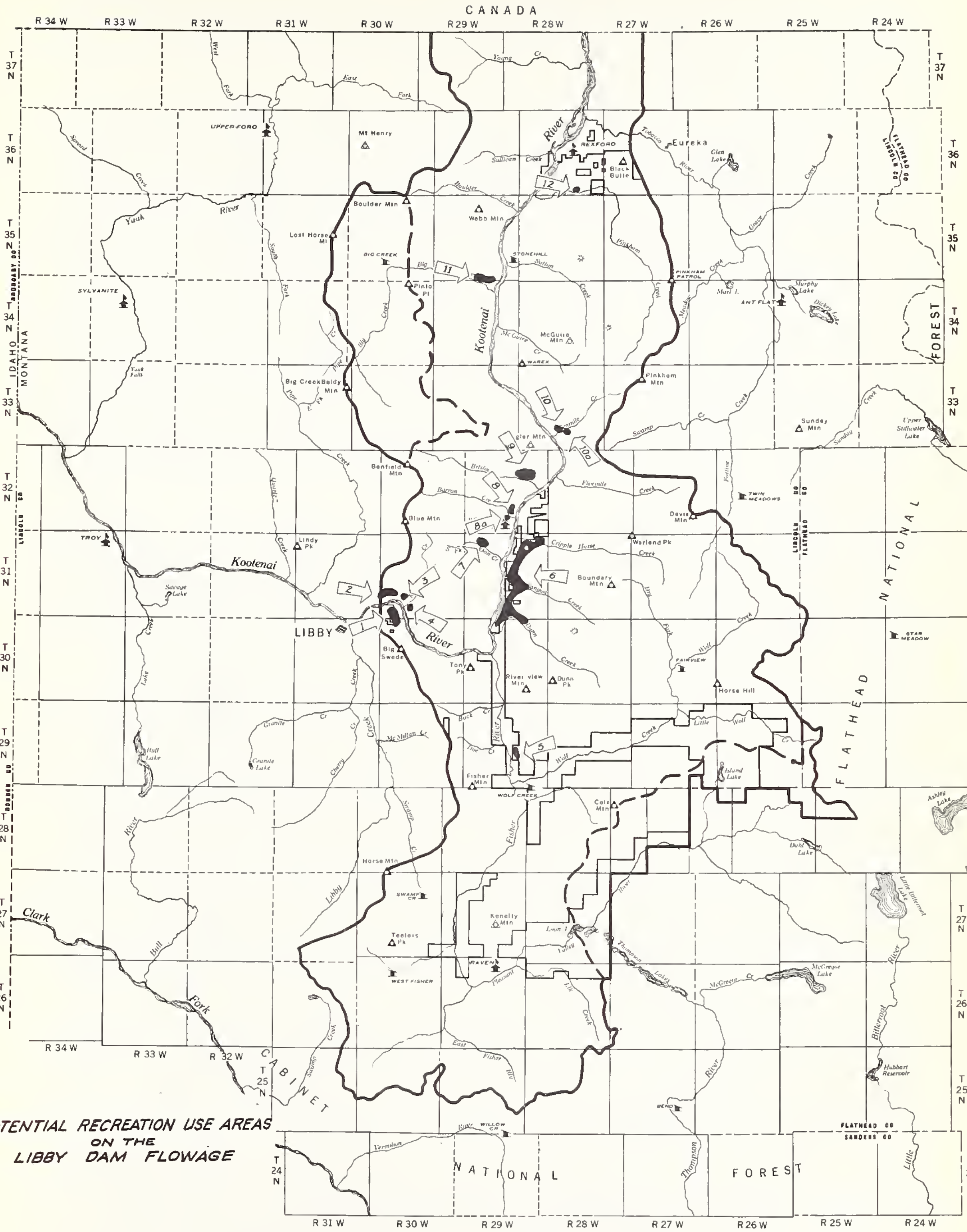
Public service facilities, such as for boating, must be distributed, if possible, at the points where such operations or utilities would provide the most convenient and maximum service. Such facilities would probably be needed at the lower and upper ends of the lake with some between, on both sides. These facilities should be at points on roads where there is good contact with the lake, and at convenient intervals of distance for breaks in small boat travel, or at other places which hold a special attraction for recreation or are strategic in the management and handling of the recreational use.

The question of possible influence of fluctuating water level on the attractiveness and practical usability of the reservoir for fishing, boating, swimming, and other water activities, and the adjacent shoreland for camping, picnicking, etc. is of material importance in recreational planning. The highest recreational use comes during the summer months. If, as anticipated, there were only a small drawdown during June, July, August, and September, recreation would not be too seriously handicapped or discouraged. On the other hand, a belt of mud slopes or other barren lake bottom ground exposed all around the margins of the lake would reduce the scenic attractiveness in proportion to the width of such an area.

A receding shoreline also creates problems in development of facilities for access to it and for the use of adjacent tracts, the uses of which are dependent upon or in connection with the use of the lake. For example, boat docking or other boat handling and service facilities are more difficult and expensive to provide where they must be designed to follow and maintain contact and connection with the water at all levels and particularly if the shoreline recedes rapidly with the drawdown. In cases where roads must contact the shore for the transfer of cargo from vehicle to water transportation or vice versa, such roads either must have roadbed materials and be on slopes or grades extending into the flowage area so they will not be damaged by inundation, or there must be some flexible system of transfer structures and equipment devised, either of which is always less satisfactory than facilities on reasonably stabilized shorelines. For these reasons it is obvious that the least suitable parts of the lake for recreational uses would be those places near the head of the flowage where the water is shallowest and the lakebed would first be exposed by relatively light drawdown. Conversely, the tracts with the most suitable conditions are those with adequate and level enough ground for developments and operations near the lake, but with the immediate shoreline slope steep enough on at least some of the frontage to insure that the water would not recede very far at times of normal drawdown during the period of recreational use.

Descriptions of tracts inventoried. The map in figure 61 shows about a dozen tracts along and adjacent to the proposed reservoir which were looked over in a general way and which, in consideration of the above-discussed factors and principles, would be of particular value for recreational use in connection with the proposed reservoir. The following numbered paragraphs correspond to the numbers on the map:

Tract 1. This area is at present accessible by a branch logging road off the J. Neils Lumber Company road up the south side of the Kootenai and Fisher Rivers. The Neils' south-side road from a little way out of Libby to some distance past the south end of the dam site is along a steep hillside where the slopes are too great and too sustained to provide any useful sites of ground. At ½ to 3/4 of a mile eastward from the dam site, a branch logging road leads up to a relatively flat bench of perhaps 10 or 15 acres. This bench would be a few feet above the high-water line of the proposed reservoir, and it is believed would provide a good site for lake access and waterfront developments. The bench lies at the lower edge of a sizable basin, near the top of a hill and tributary ridge, and slopes generally to the northward toward the main river canyon. The topography of the basin is rolling, but not rough, and is characterized by small knolls and ridges and several relatively flat shelf-like benches of a few to several acres each, on varying levels, all of which could be made accessible by roads without difficulty. The area is all timbered with Douglas-fir, ponderosa, and lodgepole pine. It has been cut-over and the larger timber removed. The slopes from this basin and its frontage into the proposed reservoir are quite steep. This close to the dam site there would always be deep water, with the shoreline not too far away even with considerable drawdown.



POTENTIAL RECREATION USE AREAS ON THE LIBBY DAM FLOWAGE

Fig. 61

It was not determined whether there was any source of domestic water supply for this tract other than created by the reservoir storage. The most usable portion is in Sections 31 and 32, T31N, R30W, and Section 5, T30N, R30W. Section 31 is private land; the other two sections are national forest.

This undoubtedly would be one of the most strategically located, useful, and valuable areas on the reservoir. It would be in demand for industrial and utility uses and some, perhaps most, of its frontage might have to be devoted primarily to those purposes. However, it is probably big enough to accommodate some recreational use also. If this location is found on further examination to warrant recreational development, this development should consist of at least public boat docking and service facilities, either publicly or commercially operated, or both, and a public camp and picnic area. The picnic and camp areas may be several hundred feet back from the lakeshore, if necessary (camping farther than the picnicking), but there should be a convenient and direct access from them to the lake for the users. The national forest ownership should safeguard the public interests. This tract has an estimated development capacity of 30 campers and 70 picnickers.

Tracts 2 and 3. These areas are at present accessible by a logging road out of Rainy Creek. They are similar in elevation and general character of ground to Tract 1 and are timbered but have been logged more heavily, and the present stand is therefore more open. The slopes being generally southerly are drier than those in Tract 1. There would not be as much ground suitable for recreation as in Tract 1, but there are a number of small benches and some larger areas of up to several acres of moderate to gently sloping ground on the tops of knolls or in bowl-like places at the heads of small, dry gulch courses. Most of this usable ground would probably be 40 to 50 feet or more above the highwater mark, but there is some frontage close to it. The slope from the edge of the tracts to the river is quite steep and being near the dam would be assured of some of the most sustained water frontage of the project. There is no surface evidence of a source of domestic water above or near the level of these tracts. Power-supplied systems from water tables which are expected to be created by the reservoir storage probably would have to be depended upon. These tracts probably would be most needed for public facilities if domestic water could be provided. It is thought that one of the higher points of Tract 2 would make a good site for viewpoint facilities. There is an excellent view from here across Libby and the surrounding valley toward the rugged mountains of the Cabinet Wilderness area and for at least 4 or 5 miles up the reservoir. This tract has an estimated capacity of 75 campers and picnickers.

Tract 4. This tract is good usable ground in a shelf-like or bench-like break and relatively steep slopes. Chance for access roads to it from Rainy Creek is good. Usable ground would be found through a distance of about ½ mile. It appears to have potentially good recreational value for the same purposes as Tracts 1, 2, and 3. Its estimated capacity is 60 picnickers and campers.

Tract 5. This tract, which it appears might be usable for some recreational development, is national forest land along the Fisher River arm of the reservoir. It is a timbered tract on the top of the first bench above the floodline of the reservoir. An undesirable feature is the fact that it would be nearer the head of this arm of the reservoir where the water would be only a few feet deep over the wide valley when full. Thus, a drawdown of as little as 10 to 15 feet would expose extensive areas of the lake bottom. For this reason this tract, as well as some of the good terrain across and back from the river on Doe and Fawn Creeks, is not expected to be of high recreational value. However, Tract 5 should be kept available for possible public needs. Its estimated capacity is 30 campers and picnickers.

Tract 6. This number is used to identify a general area extending from Cripple Horse Creek near Warland southward to Dunn Creek. It includes and represents generally the face of the slope toward the reservoir and toward the arms of the lake which would extend some distances up the side drainages of Cripple Horse, Canyon and Dunn Creeks. The topography of the slopes within the tract is not formidable and there are many areas and sites within it of level or gently sloping ground which might be developed for recreational occupancies and services. All three of the creeks named are fair size, with water satisfactory for domestic purposes. What sources of water may be available in other parts of the tract have not been explored. There should be public recreational ground developments on or near each of the three side drainage arms and each would also be a logical location for boat docks or prepared launching, landing, and loading places. One or more of these might be in connection with a public service operation, at least one of which probably would be needed in this vicinity on the east side of the reservoir, and it would be well to have available a place for it in this tract. More ground suitable for such purposes is probably available near Cripple Horse Creek than at either Canyon or Dunn Creeks. That would have to be determined by a more thorough examination. Some of the lake frontage in this tract between the side drainages might be sites suitable for youth or other organization camp developments, and this should be kept in mind in further examinations. Its estimated capacity is 200 picnickers and campers, 50 resort guests, and 100 organization campers.

Tract 7. The flowage area at elevation of 2459 feet would extend up Jackson Creek a mile and a half or more. There are 1 or 2 limited-sized sites near the junction of the north and south forks of the creek accessible at present by a logging road. The area has been logged over moderately heavy in places, but there is still a satisfactory timber cover for recreation. This is the first tract of ground suitable for recreational developments on the west side for a considerable distance above Tract 4. Because of this interval, a public camp and picnic place would be needed or desirable here. Most, if not all, of the tract is private ownership, and ground adjacent to the reservoir might not be available for public recreation unless the acquisition for the reservoir is by legal subdivisions which might include it. If necessary to use national

forest areas for campgrounds, they would be slightly farther from the lake on Jackson Creek but might not be less desirable, because of the fact that the extreme head of this arm of the lake would be subject to receding shoreline and exposed lakebottom even with moderately light drawdown. Its estimated capacity is 25 campers and picnickers.

Tracts 8 and 8a. Tract 8 is the top and the north, west, and south slopes of a prominence between Barron Creek and the river. The proposed reservoir flowage would extend up Barron Creek a mile or so, more or less encircling the tract. There would be additional partial encircling of it to the north which would leave a neck of land only a few chains wide to prevent the tract becoming an island, and over which it could be accessible by road. A logging road leads into it at that point at present, and some logging has been done over the area which has removed mainly only the scattered, large, mature trees. There is good and attractive timber cover for recreational purposes. Barron Creek Canyon below this site is almost a gorge for a half mile or more from the river so that there would be deep water in at least half of the arm of the lake adjacent to this tract. The extreme head of the flowage here would spread out over the ground varying in slope from the steep slopes of the canyon to quite flat so that it would be possible to develop points of access to the water for almost any conditions that might have to be met. There is no evidence of available water for domestic use for this tract other than from Barron Creek. The tract has topography usable enough and is of sufficient size to accommodate operation of commercial services for boats, resort facilities, and camp and picnic developments. Half or more of the tract is national forest and the remainder private ownership, which probably would be purchased in the acquisition of reservoir rights of way.

Tract 8a is on prominence directly across Barron Creek Canyon from Tract 8. It appears to be more heavily timbered and topographically is similar, although much smaller in size. It probably would not have capacity for more than one form of use of development, but is a fairly good point of access to the lake, the arm of which extends into Barron Creek Canyon offering a sheltered harbor. This arm would be deep enough to maintain fairly good connections with the lake except when there is considerable drawdown. Both Tracts 8 and 8a have high spots, excellent for viewpoints up and down the reservoir. The estimated capacity of Tracts 8 and 8a is 75 campers and picnickers and 50 resort guests.

Tract 9. On the north side of Bristow Creek from about Everett Creek eastward across Sections 10 and 11, T32N, R29W is a bench which would be above the reservoir's high waterline. This bench has a generally moderate to gentle slope with a slightly uneven or rolling surface of small knolls, low broad-topped ridges, and shallow hollows or basins. Although cutover, there is a very attractive timber cover of young-growth Douglas-fir, ponderosa pine, and lodgepole pine. There has been no logging recently in the area. There are a number of places in this tract which are suitable for recreational facilities. An arm of the reservoir lake would extend up Bristow Creek far enough

to form a long water frontage. The slope from the edge of the bench down to the creek level is steep and the water would be sufficiently deep, at least toward the east end of the tract, to permit fairly good approaches to the lake from the use areas when the drawdown is only light to moderate. The slopes eastward into the reservoir from the extreme east end of the tract are quite gradual. It is possible to find at some point adjacent to this tract almost any degree of slope that might be needed for any design of approach. No source of domestic water supply was seen on the tract other than from Everett Creek, but that is a very good fair-size stream. In the event the dam is built, this tract should be developed for camp and picnic grounds, boating and other public service facilities and operations, perhaps including general resort services with cabins, meals, etc. These types of developments and services are similar to those indicated for Tract 8. If the water frontage of Tract 9 proved to be as satisfactory as at Tract 8, Tract 9 might be the more desirable of the two, particularly for commercial facilities. Its estimated capacity is 100 campers and picnickers and 50 resort guests.

Bristow Creek is one of the probable locations of permanent logging facilities on the lake. However, the transportation planning and other reservoir project studies indicate the logging facilities would be located on the south side of the Creek. If this is done, competition between these facilities and recreational uses would be avoided or minimized.

Tracts 10 and 10a. An arm of the reservoir would extend up Ten Mile Creek about 3/4 of a mile from the river. The slopes toward the north side of Ten Mile Creek contain some bench-like breaks which are well above the high water elevation. The largest of these benches is probably not over 4 or 5 acres, with 1 or 2 smaller ones of an acre or two. The soil is a composition of clay and gravel and the slopes from the tract into the flowage area are of sufficient variety to permit developing almost any kind of approach that might be desired. This tract and the slopes above, high up the mountainside, are traversed by mountain skid roads and have been logged over. The area was logged on a careful selective basis and the remaining timber cover is a nice open stand of smaller size trees.

The recreational uses which are proposed here are camp and picnic areas, with boat landing and handling facilities, perhaps operated in connection with other commercial services since there might not be any other place for such developments for several miles either way from this point on the east side of the reservoir. Its estimated capacity is 60 campers and picnickers. Ten Mile Creek is a satisfactory stream for domestic water supply.

Tract 10a is about ½ mile up Ten Mile Creek from Tract 10 and on the south side of the creek. It is in the mouth of a side drainage and occupies what appears to be a flat or gently sloping alluvial fan. Timber cover is a moderately heavy young-growth stand.

The ground was not actually examined and the extent of the tract was not carefully determined but it is probably about the size of Tract 10. It would not be adjacent to the lakeshore but would be within convenient distance. If more area is not required for public services at Ten Mile Creek than can be accommodated on Tract 10, Tract 10a would make a good site for an organization camp or semipublic use. It would, of course, also be suitable for a summer home tract, but it probably would be prudent not to assign it to that use until it is known that all needs for lands for higher priority purposes at Ten Mile Creek are provided for. Its estimated capacity is 50 campers or 75 organization campers.

Tract 11. The flowage of the proposed reservoir extends up the Big Creek drainage some 2 miles or more. A road extends up Big Creek from the river, taking off from the state highway a mile above the mouth of the creek. The extreme eastern part of Tract 11 is a small bench area of probably not over 3 or 4 acres between the Big Creek road and the high waterline of the reservoir. The Big Creek road westward from here is just about on the proposed flowage line. The area that would be usable adjacent to the reservoir in Big Creek, therefore, is on the upper side of the present road. It is a strip between the lakeshore and the foot of the steep mountin slopes, varying in width from 2 to 5 or 6 chains. The timber is a somewhat scattered and noncommercial stand, but is a reasonably satisfactory cover for a recreational purpose. The soil is for the most part rocky, with deposits of large surface boulders in places, but there are several places where the ground is good over areas of perhaps 2 or 3 acres. Big Creek is a satisfactory stream for domestic water supply. Since this is the only tract so far found or indicated for 15 miles or more either way along the west side of the proposed reservoir, it should be held entirely for public uses. Its estimated capacity is 100 campers and picnickers.

Tract 12. This tract would not be on the shores of the reservoir, but it is included in the inventory because it is within short driving distance of the proposed relocation route of the main state highway in Study 3. It is several acres in extent, relatively level, and generally suitable for a public camp and picnic area. Once the site of a logging camp known as Camp 32, it has subsequently been used for picnic grounds. It is so listed in forest survey development records, having been improved by constructing sanitation and minor convenience facilities. Its estimated capacity is 75 campers and picnickers.

Relation of recreation to dam project. The increased recreational use resulting from the creation of the reservoir would greatly enlarge the responsibilities of the Forest Service in that field, for practically all of the prospective frontage is national forest. As compared with very limited facilities now, we see an eventual demand for: 2 organization camps with a capacity of 175 persons daily, 3 resorts with a capacity of 150 persons daily, and 13 camp and picnic grounds with a capacity of 925 persons daily. Responsibility for planning and development of the recreation facilities would be carried out in accordance with the Memorandum of

Agreement entered into between the Secretaries of War and Agriculture on December 16, 1946. The Corps would have some responsibilities for providing recreational facilities during the construction job. By coordinating the installation of such facilities with ultimate recreational needs, development of the resource could be achieved at least cost to the taxpayers.

Construction work would bring many workers and their families into the Zone of Influence. These individuals would naturally turn to the outstanding scenic attractions of the area for some of their recreation. Unfortunately, this area lacks the facilities to handle even a moderate recreational load. Failure to provide campgrounds and picnic areas to bring some order out of the use which would take place at that time could aggravate the protection problem during dry summers. Likewise, it could result in a very undesirable sanitation problem and prevent many people from enjoying otherwise available benefits.

For protection sake, it would be desirable to provide some picnic and campgrounds during the building period. The maximum daily load would be likely to run as high as 400 people. There are various places where such facilities might be developed to handle this number. It would appear good business, however, to put the effort and investment into the areas which would be used after the dam, insofar as possible. The 13 sites discussed in the preceding pages would lack the lake frontage at that time but, for the most part, they would nevertheless be attractive recreational spots. It is suggested, therefore, that sites 1, 2, 4, 9, 11, and 12 be developed as part of the dam project to the extent of providing fireplaces, tables, drinking water, and sanitary facilities. Clearing the areas, making parking places, and building the above-mentioned facilities would cost $100 a person provided for, or about $40,000.

Appendix C discusses in some detail the existing arterial road network in the Zone of Influence (Study 0) and the probable cost of completing it to the ultimate standard. The road plans of Studies 1, 2, and 3 have been compared with this network. The adequacy of Studies 4 and 5 should likewise be measured against Study 0. For that purpose the cost estimates in table 44 have been revised somewhat in table 99. This is because the portion of Highway 37 between River Miles 204.9 and 217.0 plus a few miles of other main road would no longer be involved in the dam project though they still require some improvement.

Postdam transportation planning

The dam site at River Mile 217.0 has one big advantage over the lower dam site. It would result in a much smaller dislocation of existing transportation facilities. Highway 37 could remain where it is between Libby and River Mile 217.0. The roads in the Fisher River and the heavy-duty road between Libby and the Fisher River would be undisturbed. Moreover, absence of the neck of the reservoir in the Fisher River would permit more direct routing of the railroad and the east-side road. In planning a transportation system for this dam site it has been assumed that the railroad east from Libby would remain in its present location to the mouth of Fisher River and follow the Fisher River from there to the mouth of Wolf Creek, up Wolf Creek and down Fortine Creek to rejoin the existing line near Stryker, 22 rail miles southeast of Eureka.

Above River Mile 217.0, along the Kootenai River itself, the postdam transportation problem remains the same. A railroad would be lost, a reservoir gained. Roads that now follow the watergrade of the valley bottom would be forced up the mountain slopes where going is tough and construction costs high. For that reason the transportation alternatives for Dam Site 217.0 are much the same as those for the lower site except on a smaller scale. It has been shown earlier that any system which depends on water transportation to the extent that seasonal operation is necessary is undesirable and infeasible. We have, therefore, analyzed 2 road alternatives here. They are Studies 4 and 5, which, with respect to road locations above the dam at River Mile 217.0, closely resemble Studies 2 and 3 respectively. The approach to transportation planning, and the road and water facilities designs discussed on pages 86 to 122 in relation to the lower dam site likewise form the basis for the estimates in Studies 4 and 5.

Water transportation costs

Reducing the length of the reservoir by 12 miles (217.0 - 204.9) would make a proportionately greater reduction in the volume of wood moved by water. For example, Studies 4 and 5 contemplate moving 42 percent fewer logs by water than Studies 2 and 3. Table 100 shows the average annual timber transport by water planned for each group of logging units with the dam at River Mile 217.0.

Table 99. Road costs for dam at River Mile 217.0

Revision of Study 0

	Adequate	Inadequate	Nonexisting	Total	Estimated cost: Replacement value of existing mileage	Estimated cost: Cost to complete	Estimated cost: Annual cost to maintain
	-Miles-				--Dollars--		
Main line or valley bottom roads to be inundated or affected							
State Highway 37 (dam site to U. S. Highway 93)	9.2	42.0	-	51.2	1,810,000	2,116,500	38,200
Warland-Canyon Creek 531	-	7.0	-	7.0	24,500	31,500	875
Tweed-Rexford 565	3.0	24.6	7.9	35.5	130,900	483,300	4,635
Total	12.2	73.6	7.9	93.7	1,965,400	2,631,300	43,710
Unaffected roads							
State Highway 37 (Libby to dam site)	8.3	3.9	-	12.2	734,000	58,500	8,540
All other forest development roads	198.9	314.6	440.3	953.8	4,553,790	8,713,210	108,360
Total	219.4	392.1	448.2	1,059.7	7,253,190	11,403,010	160,610

Correspondingly fewer facilities would be required for the water operations if the dam were at the upper site. Tables 102 and 103 list these facilities, their estimated original cost, probable useful life, and calculated annual cost. Note that as in Studies 1, 2, and 3 part of the cost of the water-handling facilities would be borne by the dam project and part by the timber. Table 101 shows the estimated maintenance cost of the water facilities for Studies 4 and 5. Though one more unloader would be required in the Study 4 plan, the same volume of logs and cordwood would be moved by water in each case and it is estimated the maintenance costs would be more or less equal. Table 101 also itemizes the actual operating costs from the time the logs are dumped into the water until they reach the mill. Capital charges are not included in this table. Comparison with table 56 for the lower dam site shows that water transportation is considerably more expensive in Studies 4 and 5. This is because the dam at River Mile 217.0 is 12 miles farther from Libby and the truck haul from load-out facilities to the mill would be relatively expensive. Likewise the fact that the water haul is shorter makes it somewhat less attractive.

Table 100. Average annual timber volume which would be transported by water in Studies 4 and 5

Logging unit group	Sawtimber	Cordwood
	Thousand bd.ft.	Cords
Warland	1,113	1,906
Stonehill	5,602	8,964
Rexford	4,589	5,480
Total	11,304	16,350

Table 101. Cost of maintaining and operating water facilities 1/, Dam Site 217.0

Studies 4 and 5

	Sawlogs	Cordwood
	Per thousand bd.ft.	Per cord
	Dollars	
Maintenance	1.03	.41
Bundle and into water	.39	.23
Towing	.69	.41
Load-out	.57	.34
Haul to mill	4.28	2.57
Total	6.96	3.96

1/Per thousand board feet and per cord actually moved by water. Capital cost not included.

Table 102. Investment required in water facilities and equipment, Dam Site 217.0

Study 4

Item	Initial installed cost	Years useful life	Residual value at end of term	Total annual cost of capital	Remarks
	Dollars		- --Dollars-- -		
3 unloaders A frame	150,000	20	15,000	9,042	Including installation and road access
2 unloaders crane and car 1/	380,000	33-1/3	38,000	16,204	Including installation and road access
5 inbooms and anchors 2/	15,000	10	750	1,647	Located at dumps
1 load-out crane 1/	250,000	33-1/3	25,000	10,660	At load-out point
1 outboom and anchors 1/	30,000	15	1,500	2,340	At log removal point
1 tug boat	40,000	20	4,000	2,411	100 H. P. Diesel power
1 tow cable	600	5	60	118	
4 row boats	400	6	-	72	Use around booms
4 sets boom sticks	4,800	7	240	727	Including making and chains
1 barge 1/	4,000	12	200	377	Essential to water logging
400 cable wraps	4,000	4	800	868	400 wraps and hooks
Small tools	400	1	-	410	Axes, peavies, pike poles, etc.
Total	879,200			44,876	

1/ Installed by Corps. 2/ In part by Corps.

Table 103. Investment required in water facilities and equipment, Dam Site 217.0

Study 5

Item	Initial installed cost	Years useful life	Residual value at end of term	Total annual cost of capital	Remarks
	Dollars		- - -Dollars- - -		
4 unloaders A frame	200,000	20	20,000	12,056	Including installation and road access
1 unloader crane and car 1/	190,000	33-1/3	19,000	8,102	Including installation and road access
5 inbooms and anchors 2/	15,000	10	750	1,647	Located at dumps
1 load-out crane 1/	250,000	33-1/3	25,000	10,660	At load-out point
1 outboom and anchors 1/	30,000	15	1,500	2,340	At log removal point
1 tug boat	40,000	20	4,000	2,411	100 H. P. Diesel power
1 tow cable	600	5	60	118	
4 row boats	400	6	-	72	Use around booms
4 sets boom sticks	4,800	7	240	727	Including making and chains
1 barge 1/	4,000	12	200	377	Essential to water logging
400 cable wraps	4,000	4	800	868	400 wraps and hooks
Small tools	400	1	-	410	Axes, peavies, pike poles, etc.
Total	739,200			39,788	

1/ Installed by Corps. 2/ In part by Corps.

Study 4 transportation system

Figure 62 shows the Study 4 transportation system which is generally comparable with Study 2. The chief difference is that in Study 4 it is possible to route State Highway 37 across the dam, then north along the east side of the reservoir to Five Mile Creek, up Five Mile Creek to US Highway 93 in the same location as in Study 2. As compared with 71.6 miles of new state highway construction in Study 2, only 42.3 miles would be required in Study 4. The reduction is possible because of the elimination of the highway relocation around the Fisher River arm of the reservoir. The same lower standard roads as in Study 2 are proposed along the east face of the reservoir north of Five Mile Creek to Eureka. From the dam north along the west face of the reservoir to Bristow Creek, a BB-24 construction standard is proposed. North of Bristow Creek along the west face to a connection with the existing road system opposite Rexford, the same DD-16 road construction standard as in Study 2 is proposed. A water load-out facility would be located on the east bank of the reservoir immediately upstream from the dam. This facility would be connected by a bridge across the Fisher River to the existing mainhaul road on the south side of the Kootenai River. The cost estimates of Study 4 assume that a public roadway across the dam is feasible. Should this not be the case, a bridge across the Kootenai River below the dam connecting State Highway 37 with the proposed east-side road would be necessary. The cost of the Study 4 transportation system would be increased accordingly.

No additional trails would be required. We have assumed that the existing landing field near Libby is too far from River Mile 217.0 for it to be an economical source of gravel for the dam. Accordingly, no item is included for replacing this field. The facilities which would be replaced are indicated below.

Roads

Route W, Sections A to E, inclusive, provides a yearlong log-haul and protection route along the west side of the reservoir from a connection with existing State Highway 37 below the dam to a connection above flowline with the existing road systems on the west bank opposite Rexford. No reservoir bridge crossing is provided.

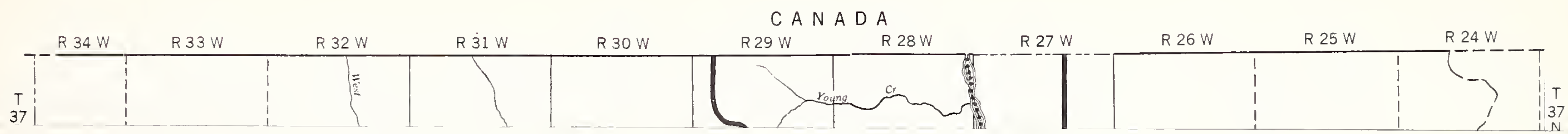
Route E, Sections B to E, inclusive, is the planned relocation of State Highway 37. Section A of Route E is not on the highway relocation route. The highway traffic comes onto Section B of Route E from the assumed public roadway across the dam.

Route E-N, Sections A to E, inclusive, provides a low-standard route along the east face of the reservoir from the highway connection at Five Mile Creek north to Eureka.

Water facilities

Since no reservoir bridge is provided by the Study 4 road system, there would be 2 project-financed "permanent" dumps located as follows:

Dump A at Pinkham Creek
Dump B at Dodge Creek



CANADA
R 34 W
R 33 W
R 32 W
R 31 W
R 30 W
R 29 W
R 28 W
R 27 W
R 26 W
R 25 W
R 24 W
T 37
T 37 N
West
Young Cr


U.S. FOREST SERVICE
LIBBY DAM PLANNING PROJECT
STUDY 4
TRANSPORTATION SYSTEM RELOCATIONS
-LEGEND-
ROAD CONST. STANDARD
STATE HIGHWAY 37 (PROJECT RESTORATION)
BB28
BB24
FOREST DEVELOPMENT ROADS (PROJECT RESTORATION)
BB28
BB24
DD16
D16
EE12
E12
TRAILS (PROJECT RESTORATION)
WATER TRANSPORTATION FACILITIES
LOADING OUT FACILITY (PROJECT RESTORATION)
PERMANENT DUMP FACILITIES (PROJECT RESTORATION)
TEMPORARY DUMP FACILITIES (NON PROJECT)
GREAT NORTHERN RAILROAD
ASSUMED RELOCATION ROUTE (PROJECT RESTORATION)
TIMBER RELOAD LANDINGS (NON PROJECT)
LANDING FIELD (PROJECT RESTORATION)
ADMINISTRATIVE IMPROVEMENTS
PROPOSED RANGER STATION (PROJECT RESTORATION)
PROPOSED WORK CENTER (PROJECT RESTORATION)
REVISED RANGER DISTRICT BOUNDARIES
CANADA
R 34 W
R 33 W
R 32 W
R 31 W
R 30 W
R 29 W
R 28 W
R 27 W
R 26 W
R 25 W
R 24 W
T 37 N
T 36 N
T 35 N
T 34 N
T 33 N
T 32 N
T 31 N
T 30 N
T 29 N
T 28 N
T 27 N
T 26 N
T 25 N
T 24 N
IDAHO
MONTANA
ROUTE E-N
ROUTE W
ROUTE E
PROPOSED LIBBY DAM RIVER MILE 217.0
Kootenai
River
LIBBY
TROY
Eureka
REXFORD
STONEHILL
WARLAND
Zeider
UPPER FORD
SYLVANITE
Mt Henry
Boulder Mtn
Lost Horse Mt
Webb Mtn
Pinto Pt
Big Creek Baldy Mtn
McGuire Mtn
Pinkham Mtn
Banfield Mtn
Blue Mtn
Lindy Pk
Davis Mtn
Wayland Pk
Boundary Mtn
Big Swede
Tony Pk
River view Mtn
Dunn Pk
Horse Hill
Sunday Mtn
Fisher Mtn
Calx Mtn
Horse Mtn
Kenelly Mtn
Teeters Pk
PINKHAM PATROL
ANT FLAT
TWIN MEADOWS
STAR MEADOW
FAIRVIEW
WOLF CREEK
SWAMP CR
RAVEN
WEST FISHER
BEND
WILLOW CR
Glen Lake
Murphy Lake
Dickey Lake
Upper Stillwater Lake
Savage Lake
Bull Lake
Granite Lake
Island Lake
Loon L
McGregor Lake
Little Bitterroot Lake
Ashley Lake
Hubbart Reservoir
Thompson Lakes
LINCOLN CO
FLATHEAD CO
SANDERS CO
BOUNDARY CO
CABINET
NATIONAL
FOREST
FLATHEAD

Fig 62

"Temporary" dumps financed by national forest timber would be required as follows:

Dump D-5 at McGuire Creek
Dump D-6 at Big Creek
Dump D-8 at Ten Mile Creek

Rail facilities

The required railroad reload landings along the relocation of the Great Northern Railway, financed by the timber operations, would be as follows:

Landing 1 at Upper Wolf Creek
Landing 2 at Wolf Prairie
Landing 3 at Tamarack Creek
Landing 4 at mouth of Wolf Creek

The Study 4 road system provides main haul access to all timber areas and no supplementary access roads to be financed by timber operations would be required.

It is proposed to locate a ranger station for the new Warland Ranger District adjacent to the dam at Dunn Creek on the east side of the reservoir. The work center would be on proposed Highway 37 at Warland Creek. Since no bridge crossing is provided at the north end of the reservoir it becomes necessary to create a new ranger district on the west side, with headquarters at Big Creek. The Rexford Ranger Station (relocated at Eureka) is still required for the east side district at the north end of the reservoir.

The cost analysis of the Study 4 road system is summarized in table 104.

Table 105 indicates the mode of transporting wood from each logging unit. Following is an explanation of each route shown in figure 62.

Route W, with a total length of 50.9 miles, is on the same location for the same reasons as corresponding sections of Routes W and W-N of Study 5.

Section A, 1.3 miles long and proposed for a BB-28 construction standard, is the connection for the relocation of State Highway 37 from the existing highway, across the dam, to the beginning of Section B of highway Route E.

Section B, although not a part of Highway 37 relocation, provides the same service to the transportation of timber from west-side logging units as in Study 5. It also provides for hauling of winter production from north end units 100, 101, and 102. In addition, because of the recreational attractions along the west side of the reservoir north to Bristow Creek, it is estimated 15,000 recreational cars and 2500 commercial vehicles would use this route. A BB-24 construction standard is recommended to safely accommodate the combined public and utilization traffic.

Table 104. Summary of road system cost analyses

Study 4

	Unit	Route						Entire system
		W	W-N	S	P	E	E-N	
Length	Miles	50.9	-	-	-	42.4	37.4	130.7
Total construction cost	Dollars	6,618,787	-	-	-	4,296,443	2,695,451	13,610,681
Annual road cost								
Construction	Dollars	281,299	-	-	-	182,598	114,557	578,454
Maintenance	Dollars	29,615	-	-	-	36,480	5,768	71,863
Total	Dollars	310,914	-	-	-	219,078	120,325	650,317
Annual transportation cost								
Wood products	Dollars	45,894	-	-	-	32,744	13,304	91,942
Mineral products	Dollars	-	-	-	-	-	-	-
Recreational travel	Dollars	39,095	-	-	-	207,220	8,014	254,329
Commercial travel	Dollars	29,483	-	-	-	180,103	9,652	219,238
National forest administration	Dollars	12,402	-	-	-	8,692	8,084	29,178
Total	Dollars	126,874	-	-	-	428,759	39,054	594,687
Total annual road and transportation cost	Dollars	437,788	-	-	-	647,837	159,379	1,245,004

Table 105. Annual cut by logging units and mode of transporting wood

Study 4

Logging unit	Summer cutting: Sawlogs	Summer cutting: Pulpwood	Summer cutting: Mode of transport	Winter cutting: Sawlogs	Winter cutting: Pulpwood	Winter cutting: Mode of transport
	Thousand bd.ft.	Cords		Thousand bd.ft.	Cords	
			Libby group			
80	232	468	Truck via existing Highway 37	-	-	-
81	716	1,314	Truck via existing Highway 37	-	-	-
82	365	584	Truck via existing Highway 37	-	-	-
84	589	1,042	Truck via Routes W and E	-	-	-
113	1,290	2,243	Truck via Route E	511	712	Truck via Route E
179	795	1,286	Truck via existing Libby-Jennings road	-	-	-
			Warland group			
85	171	312	Truck via Routes W and E	-	10	-
86	354	614	Truck via Routes W and E	489	847	Truck via Routes W and E
87	479	823	Truck via Routes W and E	434	744	Truck via Routes W and E
88	744	1,177	Truck via Routes W and E	611	1,050	Truck via Routes W and E
89	438	759	Truck via Routes W and E	-	-	-
108	111	-	Truck to water - no planned dump	-	-	-
108	1,002	1,906	Truck to Dump 8	141	68	Truck via Route E
109	1,202	1,974	Truck via Route E	233	212	Truck via Route E
110	195	470	Truck via Route E	411	498	Truck via Route E
111	1,164	1,994	Truck via Route E	695	1,114	Truck via Route E
112	571	1,214	Truck via Route E	496	768	Truck via Route E
			Stonehill group			
90	566	889	Truck to Dump 6			
91	621	1,133	Truck to Dump 6			
94	700	1,250	Truck to Dump 6			
97	716	1,007	Truck to Dump 6			
98	453	808	Truck to Dump 6			
106	1,641	2,160	Truck to Dump A			
107	905	1,717	Truck to Dump 5			
			Rexford group			
99	973	895	Truck to Dump B	-	-	-
100	669	932	Truck to Dump B	474	615	Truck via Routes W and E
101	387	555	Truck to Dump B	332	476	Truck via Routes W and E
102	769	1,119	Truck to Dump B	754	1,221	Truck via Routes W and E
103	659	891	Truck to Dump A	940	1,318	Truck-rail via Eureka
104	207	249	Truck to Dump A	1,139	1,367	Truck-rail via Eureka
105	925	839	Truck to Dump A	670	603	Truck-rail via Eureka
			Lower Fisher group			
151	455	753	Truck via existing Libby-Jennings road	134	183	Truck via existing Libby-Jennings road
152	499	727	Truck via existing Libby-Jennings road	90	108	Truck via existing Libby-Jennings road
153	343	480	Truck via existing Libby-Jennings road	62	83	Truck via existing Libby-Jennings road
154	450	484	Truck via existing Libby-Jennings road	235	205	Truck via existing Libby-Jennings road
155	207	565	Truck via existing Libby-Jennings road	438	507	Truck via existing Libby-Jennings road
			Mid-Fisher group			
149	595	754	Truck-rail via Landing 4	113	143	Truck-rail via Landing 4
156	401	402	Truck-rail via Landing 4	236	237	Truck-rail via Landing 4
157	217	213	Truck-rail via Landing 4	67	65	Truck-rail via Landing 4
158	226	209	Truck-rail via Landing 4	149	137	Truck-rail via Landing 4
160	671	758	Truck-rail via Landing 4	204	231	Truck-rail via Landing 4
161	247	257	Truck-rail via Landing 4	70	73	Truck-rail via Landing 4
162	282	294	Truck-rail via Landing 4	154	199	Truck-rail via Landing 4
163	489	465	Truck-rail via Landing 4	122	116	Truck-rail via Landing 4
			Upper Fisher group			
174	850	1,284	Truck via U.S. Highway 2	102	154	Truck via U.S. Highway 2
164	30	24	Truck via U.S. Highway 2	114	89	Truck via U.S. Highway 2
165	316	259	Truck via U.S. Highway 2	376	307	Truck via U.S. Highway 2
166	272	204	Truck via U.S. Highway 2	408	305	Truck via U.S. Highway 2
167	475	869	Truck via U.S. Highway 2	119	217	Truck via U.S. Highway 2
168	1,569	2,639	Truck via U.S. Highway 2	11	18	Truck via U.S. Highway 2
169	1,951	3,268	Truck via U.S. Highway 2	-	-	-
170	471	549	Truck via U.S. Highway 2	23	27	Truck via U.S. Highway 2
171	1,588	2,403	Truck via U.S. Highway 2	-	-	-
172	1,031	1,134	Truck via U.S. Highway 2	437	482	Truck via U.S. Highway 2
173	431	307	Truck via U.S. Highway 2	204	143	Truck via U.S. Highway 2
			Wolf Creek group			
139	2,270	3,515	Truck-rail via Landing 1	-	-	-
140	1,039	1,517	Truck-rail via Landing 2	460	671	Truck-rail via Landing 2
141	436	531	Truck-rail via Landing 2	76	92	Truck-rail via Landing 2
142	1,479	1,320	Truck-rail via Landing 2	531	532	Truck-rail via Landing 2
143	327	493	Truck-rail via Landing 2	306	461	Truck-rail via Landing 2
144	1,530	1,807	Truck-rail via Landing 3	429	506	Truck-rail via Landing 3
150	756	692	Truck-rail via Landing 4	230	210	Truck-rail via Landing 4
Total for zone of influence (except logging units 92, 93, 95, 96)	42,512	61,800		14,230	18,124	

Sections C, D, and E are identical in length, service, recommended construction standard, and cost to Sections E, F, and G, respectively, of Route W of Study 2.

Route W, entailing a 140-mile round trip to Libby, is the only practicable outlet for those families living within the Zone of Influence at the northwest end of the reservoir. The usability of that outlet during winter months would depend upon snow removal in connection with timber hauling. It is unlikely that Lincoln County could perform the snow removal job during those periods if timber were not being hauled over this route.

Route E, except for Section A, is the Study 4 relocation of State Highway 37.

Section A, 3.0 miles long, is identical to Section A of Route E of Study 5. It provides for the truck haul of timber from the load-out facility near the dam. It also would carry the summer and winter logs hauled directly to Libby via the Libby-Jennings road from west and east-side logging units as far north as Geibler and Five Mile Creeks and the winter production from units 100, 101, and 102. In calculating the timber transportation costs, the 1.6-mile travel distance across the dam and east abutment area has been included for the west-side timber production which is trucked direct to Libby. This section is recommended for a BB-28 construction standard.

Section B, 7.4 miles long, is a part of the State Highway 37 relocation and is recommended for a BB-28 construction standard to permit the log haul economies of "off-highway" equipment. It is estimated that 50,000 recreational cars and 30,000 commercial vehicles would travel this section each year. It would handle all of the wood production along the east side of the reservoir north to Ten Mile Creek. The 1.6-mile distance across the dam and east abutment area has been added to the 7.4-mile length of this section in calculating the transportation costs, via Route E, of the public and forest administration traffic.

Section C is also part of State Highway 37 relocation. It carries the same estimated public traffic as preceding Section B and is proposed for the same BB-28 construction standard, since the use of "off-highway" equipment on the comparatively long through haul to Libby would result in substantial savings in timber transportation costs.

Sections D and E are identical in location, service, construction standard (BB-24), and cost to corresponding Sections F and G of Route E of Study 2.

Route E-N is identical in all respects to Route E-N of Study 2.

Table 106 summarizes the total estimated construction and maintenance cost of the transportation facilities which are planned for restoration in Study 4 except for the water facilities.

Table 106. Summary of recommended Libby project transportation system restoration costs, except water facilities

Study 4

	Construction		Annual costs			Annual timber volumes served	
	Miles	Cost	Capital	Maintenance	Total	Sawlogs	Pulpwood
	- - - - - - - -	Dollars	- - - - - - - -			Thousand bd.ft.	Cords
Roads							
State Highway 37 relocation 1/	42.3	3,990,124	169,580	34,320	203,900	5,108	8,873
All other	90.0	9,620,557	408,874	37,543	446,417	20,362	31,409
Total	132.3	13,610,681	578,454	71,863	650,317	25,470	40,282

1/Includes 1.6 miles across the dam and approaches.

Study 5 transportation system

Figure 63 shows the Study 5 transportation system. It is very similar to Study 3 for the lower dam site except that Highway 37 follows the reservoir for the entire distance between Mile 217.0 and Webb Mountain, and the east-side road crosses the river on the dam. Downstream from River Mile 217.0 the east-side road is connected by a bridge across the Fisher River with the existing, and undisturbed, main log-haul Libby-Jennings Road 759. The water load-out facility would be located on the east bank of the reservoir immediately upstream from the dam, and the above road would serve as the truck route to Libby for all water-transported timber as well as for the east-side timber north to Five Mile Creek, which is trucked direct. Likewise, it would serve for direct trucking of west-side timber from as far north as Geibler Creek. This timber would be routed across a proposed roadway on the dam itself. In Study 5 it is considered that use of a roadway on the dam would be restricted to commercial traffic. The construction standards of the east-side road are based on the assumption that no public traffic would be fed out on it from the roadway crossing the dam as the relocation of State Highway 37 is available on the west side.

As in Study 4, no additional trails would be required under the Study 5 transportation system. Likewise, it has been assumed that the existing landing field at Libby would not become a source of gravel for the dam and, therefore, would not need to be replaced. The facilities which would be replaced are indicated below:

Roads

Route W, Sections A to G, inclusive, is the planned relocation of State Highway 37, and calls for a bridge crossing of the reservoir (Section F) in the vicinity of Webb Mountain.

Route W-N provides a log-haul road on the west side of the reservoir connecting Route W at the proposed bridge with the existing road system above flowline on the west bank opposite Rexford.

Route E, Sections A to G, inclusive, provides a log-haul and protection road along the east face of the reservoir connecting with Route W at the proposed bridge.

Water facilities

As in Study 3 of the lower dam site, because the winter production of timber from logging units at the northwest end of the reservoir could be trucked across the proposed reservoir bridge, as could the summer production from tributary logging units, only one project-financed "permanent" dump would be required. It would be Dump D-A at Pinkham Creek.

"Temporary" dumps to be financed by national forest timber sales would be required as follows:

Dump D-5 at McGuire Creek
Dump D-6 at Big Creek
Dump D-7 at Dodge Creek
Dump D-8 at Ten Mile Creek

Project-financed load-out facility on east bank of reservoir immediately adjacent to dam.

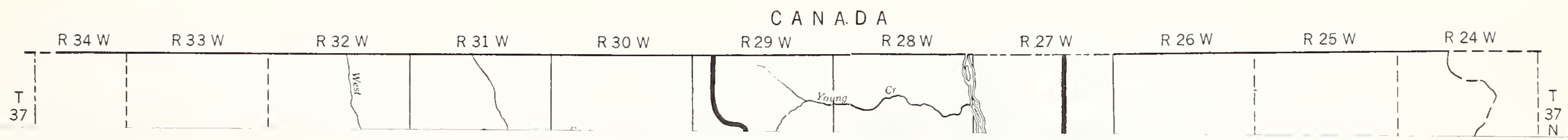
Rail facilities

Four railroad landings along the proposed Study 5 location of the Great Northern Railway would be financed by the timber operations:

Landing 1 at Upper Wolf Creek
Landing 2 at Wolf Prairie
Landing 3 at Tamarack Creek
Landing 4 at mouth of Wolf Creek

As opposed to the situation with the dam at River Mile 204.9, the transportation system of Study 5, together with the undisturbed roads in the Fisher River and along the Kootenai River below the Fisher, provides access to all timber areas. No supplementary access roads financed by timber operations would be required.

As mentioned earlier, the dam itself would provide a roadway connecting the west and east-side road routes at the lower end of the reservoir. This connection, together with the connection provided by the bridge crossing at the north end of the reservoir, would avoid the necessity for any significant changes in existing administrative boundaries. Since, under Study 5, the Warland Ranger District could continue to lie on both sides of the reservoir, it is proposed to locate the ranger station at Libby with a work center at Wolf Creek.


CANADA
R 34 W
R 33 W
R 32 W
R 31 W
R 30 W
R 29 W
R 28 W
R 27 W
R 26 W
R 25 W
R 24 W
T 37
T 37 N
West
Young Cr

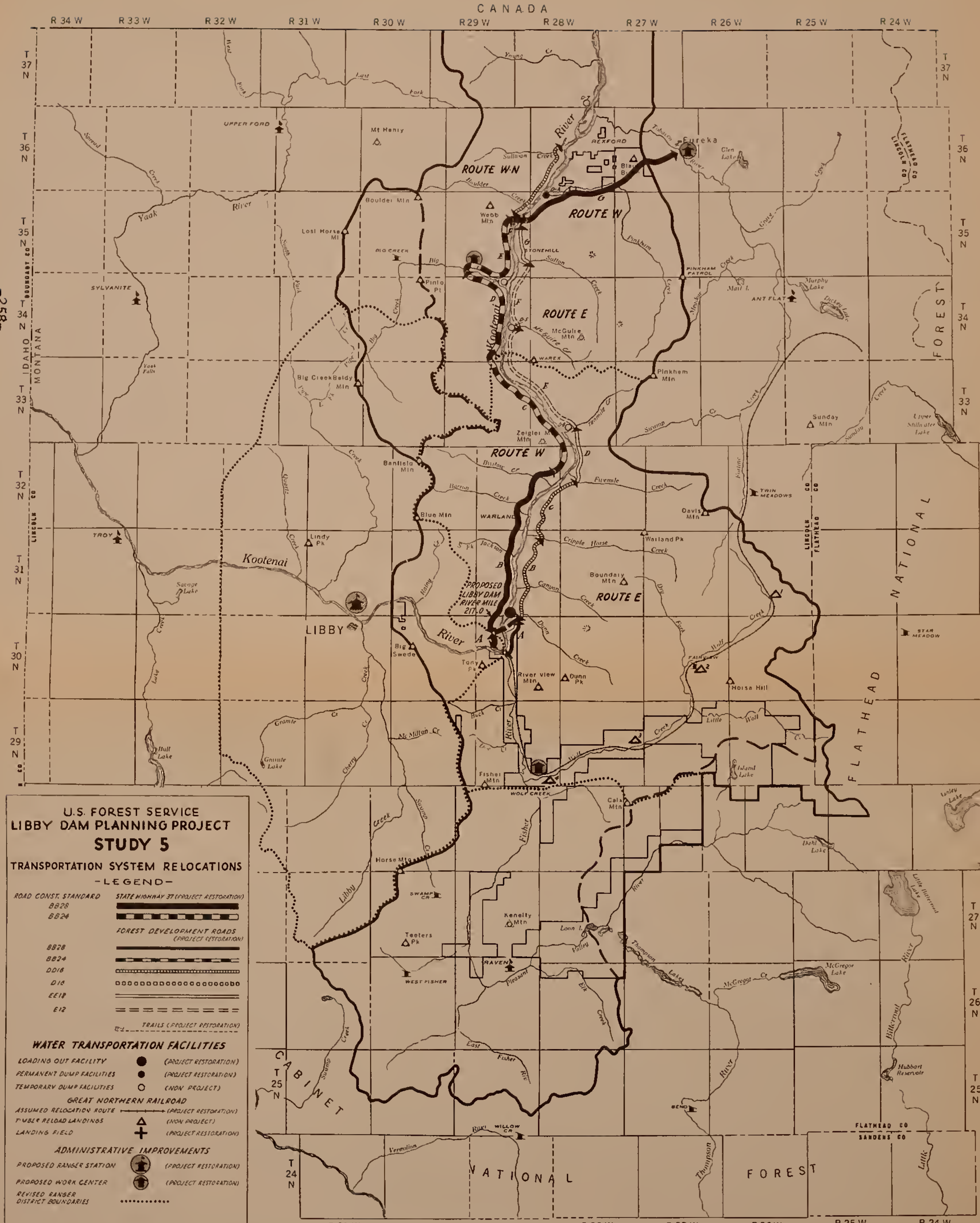

CANADA
U.S. FOREST SERVICE
LIBBY DAM PLANNING PROJECT
STUDY 5
TRANSPORTATION SYSTEM RELOCATIONS
-LEGEND-
ROAD CONST. STANDARD
STATE HIGHWAY 37 (PROJECT RESTORATION)
BB28
BB24
FOREST DEVELOPMENT ROADS (PROJECT RESTORATION)
BB28
BB24
DD18
D18
EE18
E12
TRAILS (PROJECT RESTORATION)
WATER TRANSPORTATION FACILITIES
LOADING OUT FACILITY (PROJECT RESTORATION)
PERMANENT DUMP FACILITIES (PROJECT RESTORATION)
TEMPORARY DUMP FACILITIES (NON PROJECT)
GREAT NORTHERN RAILROAD
ASSUMED RELOCATION ROUTE (PROJECT RESTORATION)
TIMBER RELOAD LANDINGS (NON PROJECT)
LANDING FIELD (PROJECT RESTORATION)
ADMINISTRATIVE IMPROVEMENTS
PROPOSED RANGER STATION (PROJECT RESTORATION)
PROPOSED WORK CENTER (PROJECT RESTORATION)
REVISED RANGER DISTRICT BOUNDARIES
ROUTE W-N
ROUTE W
ROUTE E
PROPOSED LIBBY DAM RIVER MILE 217.0
Eureka
REXFORD
LIBBY
TROY
Kootenai River
IDAHO
MONTANA
BOUNDARY CO
LINCOLN CO
FLATHEAD CO
SANDERS CO
FLATHEAD NATIONAL FOREST
CABINET NATIONAL FOREST

Fig 63

The cost analysis of the Study 5 road system is summarized in table 107. Table 108 shows the means which would be used for transporting the wood from each logging unit.

The details of route and construction standard selection are explained in the following paragraphs:

Route W. State Highway 37 relocation route takes off from the existing highway approximately 12.7 miles east of Libby, and climbs to elevation 2460 at the dam site, from which point it extends north on the reservoir face location of corresponding sections of Routes W-A and W as described in Study 3. The decision to use the part of Route W-A, Study 3, a reservoir face location north of the dam site, may need explanation as it was rejected under Study 3. Section B, 15.1 miles long, is estimated to cost $2,661,100 for a BB-28 construction standard. Equivalent Sections C and D, 24.1 miles long, of Route W, Study 3, were estimated to cost $2,363,465 which is 11 percent less. However, annual maintenance costs are $12,080 and $24,100, respectively, favoring the reservoir face location. The reservoir face location provides a direct, favorable grade timber haul route to Libby tying in with the Libby-Jennings road via the roadway on the dam. The advantage of this route from the standpoint of timber haul, maintenance costs, public traffic, and maximum salvage of the existing highway are sufficient to offset the somewhat higher construction costs of this location.

It is estimated that the volume of through public traffic over Route W would be 60,000 recreational cars and 45,000 commercial vehicles the same as Study 3. Likewise, it is estimated the traffic over end sections of the route would be heavier than on the intervening sections. To accommodate this traffic along with the heavy traffic of log-haul trucks, and for the reasons discussed under Route W of Study 3, a BB-28 construction standard is recommended for Sections A and B at the south end, and for Sections F and G at the north end. Sections C, D, and E, subjected to relatively light log-haul traffic are proposed for a BB-24 construction standard.

Route W-N is identical in location, length, service, recommended construction standard, and cost as Route W-N under Study 3. In addition to its services to timber transportation, Route W-N, together with the reservoir bridge crossing, provides the only reasonable yearlong outlet to Eureka for the west-side families in the Tooley Lake area.

Route E extends from a connection with the existing Libby-Jennings forest development road 759 on the west side of the Fisher River, across the Fisher River and, by a grade separation structure, over the proposed relocation of the Great Northern Railway on the east side of the Fisher, climbs over the east abutment of the dam and continues north along the east face of the reservoir to the proposed bridge on the same location as Route E of Study 3.

Table 107. Summary of road system cost analyses

Study 5

	Unit	Route						Entire system
		W	W-N	S	P	E	E-N	
Length	Miles	57.6	7.5	-	-	39.6	-	104.7
Total construction cost	Dollars	15,808,650	703,778	-	-	3,038,391	-	19,550,819
Annual road cost								
Construction	Dollars	671,868	29,911	-	-	129,131	-	830,910
Maintenance	Dollars	65,410	3,750	-	-	13,197	-	82,357
Total	Dollars	737,278	33,661	-	-	142,328	-	913,267
Annual transportation cost								
Wood products	Dollars	28,111	4,598	-	-	36,444	-	69,153
Mineral products	Dollars	-	-	-	-	-	-	-
Recreational travel	Dollars	406,900	9,750	-	-	7,141	-	423,791
Commercial travel	Dollars	438,761	3,938	-	-	6,975	-	449,674
National forest administration	Dollars	13,423	1,181	-	-	8,180	-	22,783
Total	Dollars	887,194	19,467	-	-	58,740	-	965,401
Total annual road and transportation cost	Dollars	1,624,472	53,128	-	-	201,068	-	1,878,668

Tabla 108. Annual cut by logging units and moda of transporting wood

Study 5

Logging unit	Summer cutting: Sawlogs	Summer cutting: Pulpwood	Summer cutting: Moda of transport	Wintar cutting: Sawlogs	Wintar cutting: Pulpwood	Wintar cutting: Moda of transport
	Thousand bd.ft.	Cords		Thousand bd.ft.	Cords	
			Libby group			
80	232	468	Truck via existing Highway 37	-	-	-
81	716	1,314	Truck via axisting Highway 37	-	-	-
82	365	584	Truck via axisting Highway 37	-	-	-
84	589	1,042	Truck via Routas W and E	-	-	-
113	1,290	2,243	Truck via Routa E	511	712	Truck via Routa E
179	795	1,286	Truck via axisting Libby-Jennings road	-	-	-
			Warland group			
85	171	312	Truck via Routes W and E	-	10	-
86	354	614	Truck via Routas W and E	489	847	Truck via Routes W and E
87	479	823	Truck via Routas W and E	434	744	Truck via Routes W and E
88	744	1,177	Truck via Routes W and E	611	1,050	Truck via Routes W and E
89	438	759	Truck via Routes W and E	-	-	-
108	111	-	Truck to water - no plannad dump	-	-	-
108	1,002	1,906	Truck to Dump 8	141	68	Truck via Routa E
109	1,202	1,974	Truck via Route E	233	212	Truck via Route E
110	195	470	Truck via Route E	411	498	Truck via Route E
111	1,164	1,994	Truck via Route E	695	1,114	Truck via Routa E
112	571	1,214	Truck via Route E	496	768	Truck via Route E
			Stonehill group			
90	566	889	Truck to Dump 6			
91	621	1,133	Truck to Dump 6			
94	700	1,250	Truck to Dump 6			
97	716	1,007	Truck to Dump 6			
98	453	808	Truck to Dump 6			
106	1,641	2,160	Truck to Dump A			
107	905	1,717	Truck to Dump 5			
			Raxford group			
99	973	895	Truck to Dump 6	-	-	-
100	669	932	Truck to Dump 7	474	615	Truck-rail via Eureka
101	387	555	Truck to Dump 7	332	476	Truck-rail via Eureka
102	769	1,119	Truck to Dump 7	754	1,221	Truck-rail via Eureka
103	659	891	Truck to Dump A	940	1,318	Truck-rail via Eureka
104	207	249	Truck to Dump A	1,139	1,367	Truck-rail via Eureka
105	925	839	Truck to Dump A	670	603	Truck-rail via Eureka
			Lower Fishar group			
151	455	753	Truck via existing Libby-Jennings road	134	183	Truck via existing Libby-Jennings road
152	499	727	Truck via axisting Libby-Jennings road	90	108	Truck via existing Libby-Jennings road
153	343	480	Truck via axisting Libby-Jennings road	62	83	Truck via existing Libby-Jennings road
154	450	484	Truck via axisting Libby-Jennings road	235	205	Truck via existing Libby-Jennings road
155	207	565	Truck via existing Libby-Jennings road	438	507	Truck via existing Libby-Jennings road
			Mid-Fisher group			
149	595	754	Truck-rail via Landing 4	113	143	Truck-rail via Landing 4
156	401	402	Truck-rail via Landing 4	236	237	Truck-rail via Landing 4
157	217	213	Truck-rail via Landing 4	67	65	Truck-rail via Landing 4
158	226	209	Truck-rail via Landing 4	149	137	Truck-rail via Landing 4
160	671	758	Truck-rail via Landing 4	204	231	Truck-rail via Landing 4
161	247	257	Truck-rail via Landing 4	70	73	Truck-rail via Landing 4
162	282	294	Truck-rail via Landing 4	154	199	Truck-rail via Landing 4
163	489	465	Truck-rail via Landing 4	122	116	Truck-rail via Landing 4
			Upper Fisher group			
174	850	1,284	Truck via U.S. Highway 2	102	154	Truck via U.S. Highway 2
164	30	24	Truck via U.S. Highway 2	114	89	Truck via U.S. Highway 2
165	316	259	Truck via U.S. Highway 2	376	307	Truck via U.S. Highway 2
166	272	204	Truck via U.S. Highway 2	408	305	Truck via U.S. Highway 2
167	475	869	Truck via U.S. Highway 2	119	217	Truck via U.S. Highway 2
168	1,569	2,639	Truck via U.S. Highway 2	11	18	Truck via U.S. Highway 2
169	1,951	3,268	Truck via U.S. Highway 2	-	-	-
170	471	549	Truck via U.S. Highway 2	23	27	Truck via U.S. Highway 2
171	1,588	2,403	Truck via U.S. Highway 2	-	-	-
172	1,031	1,134	Truck via U.S. Highway 2	437	482	Truck via U.S. Highway 2
173	431	307	Truck via U.S. Highway 2	204	143	Truck via U.S. Highway 2
			Wolf Creek group			
139	2,270	3,515	Truck-rail via Landing 1	-	-	-
140	1,039	1,517	Truck-rail via Landing 2	460	671	Truck-rail via Landing 2
141	436	531	Truck-rail via Landing 2	76	92	Truck-rail via Landing 2
142	1,479	1,320	Truck-rail via Landing 2	531	532	Truck-rail via Landing 2
143	327	493	Truck-rail via Landing 2	306	461	Truck-rail via Landing 2
144	1,530	1,807	Truck-rail via Landing 3	429	506	Truck-rail via Landing 3
150	756	692	Truck-rail via Landing 4	230	210	Truck-rail via Landing 4
Total for zona of influenca (excapt logging units 92, 93, 95, 96)	42,512	61,800		14,230	18,124	

Section A, 3.0 miles long, provides for the truck haul of timber from the load-out facility as well as for the direct haul to Libby, via the Libby-Jennings road, of both summer and winter timber production from west and east-side logging units as far north as Geibler and Five Mile Creeks, respectively. It is accordingly recommended for a BB-28 construction standard. One and six-tenths miles have been added to the travel distance of timber originating from west-side logging units. This extra mileage allows for the distance across the dam and east abutment area to a connection with Section A.

Section B, 7.4 miles long, is shorter than the equivalent 7.6-mile Section D, Route E, Study 3, because the dam is located immediately above the mouth of Dunn Creek and the road location is not forced as far up this side-drainage.

Timber from east-side logging units 109 to 113, inclusive, would be trucked direct to Libby; timber from logging unit 108 would be trucked to Dump 8 at the mouth of Ten Mile Creek. Otherwise, Sections C, D, E, F, and G are identical in location, length, service, recommended construction standard, and cost to corresponding Sections E, F, G, H, and I, respectively, Route E, Study 3.

Table 109 summarizes the total Study 5 estimated construction and annual costs of the Libby project transportation restoration. It also summarizes the annual cut which would be served by the planned road system.

Table 109. Summary of recommended Libby project transportation system restoration costs, except water facilities

Study 5

	Construction		Annual costs			Annual timber volumes served	
	Miles	Cost	Capital	Maintenance	Total	Sawlogs	Pulpwood
		Dollars				Thousand bd.ft.	Cords
Roads							
State Highway 37 relocation	57.6	15,808,650	671,868	65,410	737,278	11,877	18,182
All other 1/	48.7	3,742,169	159,042	16,947	175,989	13,593	22,100
Total	106.3	19,550,819	830,910	82,357	913,267	25,470	40,282

1/ Including 1.6 miles of road across the dam and approaches.

Comparison of road cost analyses of Studies 4 and 5

As with the comparisons of Studies 1, 2, and 3, this summary discussion limits itself to a comparison of the road costs and road services under Studies 4 and 5. Table 110 compares the construction and travel costs of the two studies. No comparison should be made between the summary figures in table 110 and those in table 67. The traffic costs in each case are

Table 110. Summary of road system analyses

Studies 4 and 5

	Miles	Construction cost	Annual road cost: Capital	Annual road cost: Maintenance	Annual road cost: Total	Timber transportation: Annual volume served 1/	Timber transportation: Thousand bd.ft.-miles	Timber transportation: Annual transportation cost	Timber transportation: Cost per thousand bd.ft.
		- - - - - - - - -Dollars- - - - - - - -				Thousand bd.ft.		- - - - -Dollars- - - -	
Study 4									
State Highway 37 relocation	42.3	3,990,124	169,580	34,320	203,900	8,657	87,918	13,229	1.53
All other roads	90.0	9,620,557	408,874	37,543	446,417	32,926	420,744	78,713	2.39
Total	132.3	13,610,681	578,454	71,863	650,317	41,583	508,662	91,942	2.21
Study 5									
State Highway 37 relocation	57.6	15,808,650	671,868	65,410	737,278	19,150	181,807	28,111	1.47
All other roads	48.7	3,742,169	159,042	16,947	175,989	22,433	223,613	41,042	1.83
Total	106.3	19,550,819	830,910	82,357	913,267	41,583	405,420	69,153	1.66

1/Including cordwood at the rate of 2.5 cords per 1000 board feet.

	Public travel: Recreational: Vehicle miles	Public travel: Recreational: Annual transportation cost	Public travel: Commercial: Vehicle miles	Public travel: Commercial: Annual transportation cost	Public travel: Total: Vehicle miles	Public travel: Total: Annual transportation cost	Administration and protection travel: Vehicle miles	Administration and protection travel: Annual transportation cost	Total annual transportation cost	Total annual road and transportation costs
		Dollars		Dollars		Dollars		Dollars	- - - - Dollars - - - -	
Study 4										
State Highway 37 relocation	2,108,500	216,320	1,258,600	193,824	3,367,100	410,144	55,850	8,600	431,973	635,873
All other roads	326,855	38,009	128,122	25,414	454,977	63,423	98,767	20,578	162,714	609,131
Total	2,435,355	254,329	1,386,722	219,238	3,822,077	473,567	154,617	29,178	594,687	1,245,004
Study 5										
State Highway 37 relocation	3,941,000	406,900	2,849,100	438,761	6,790,100	845,661	87,150	13,423	887,194	1,624,472
All other roads	126,925	16,891	50,390	10,913	177,315	27,804	40,275	9,360	78,207	254,196
Total	4,067,925	423,791	2,899,490	449,674	6,967,415	873,465	127,425	22,783	965,401	1,878,668

for the mileage of the restored road system only. A complete analysis of the cost effects of each transportation system is presented in the body of the report.

Miles of construction. Including the 1.6 miles of road across the dam and east abutment area that would be built as part of the dam, 132.3 miles of road would be built under Study 4. Study 5 calls for the construction of 106.3 miles of all roads. The greater mileage of Study 4 is due to the Highway 37 route up Five Mile Creek and down Fortine Creek, outside the Zone of Influence, to US Highway 93. It is significant to note that the Highway 37 construction of Study 5 is 57.6 miles long, of which all but approximately 3.0 miles are inside the Zone of Influence. The Highway 37 construction of Study 4 is 15.3 miles shorter, although 18.2 miles of it are outside the Zone of Influence.

Total cost of construction. The 42.3-mile Highway 37 relocation route of Study 4 with more than half its length away from the reservoir on generally favorable construction topography and with no reservoir bridge is estimated to cost $94,000 a mile. The 90.0 miles of "all other roads," all along the reservoir faces and including 15 miles of BB-24 construction standard, average almost $107,000 a mile.

In contrast, the 57.6-mile Highway 37 construction in Study 5 is mainly along the difficult reservoir face. The cost of this construction, including the reservoir bridge crossing, would be about $274,000 a mile. The 48.7 miles of "all other roads" which consist of lower standard roads along the reservoir face are almost $77,000 a mile. Including all roads, it is estimated that the original cost of the Study 4 road plan would be $5,940,000 less than for the Study 5 plan.

Annual maintenance. The Study 4 routing of Highway 37 has fewer miles of BB-28 road than the Study 5 plan, but it goes over a 4100-foot pass at the head of Five Mile Creek where snow removal costs would be high. Thus it is estimated that the annual cost of maintaining this road would be $811 a mile. The average annual maintenance cost of the Study 5 highway route would be $776 a mile, plus $21,000 annually for maintaining the reservoir bridge.

The annual maintenance cost of "all other roads" included in Study 4 is $417 a mile and in Study 5, $348 a mile. More of the Study 4 "all other roads" would be in yearlong operation, hence the higher maintenance costs.

Mainline timber truck haul

So far as timber hauling is concerned, the Study 5 road system has two major advantages over the Study 4 road system. Because there is a bridge crossing of the reservoir in the Study 5 plan it is not necessary to truck the winter logs from the northwest corner of the Zone of Influence all the way to Libby. Both truck and total transportation costs can be reduced by hauling by rail from Eureka to Libby.

The other advantage of Study 5 is that the highway in this location would be of far greater utility for timber haul. Inasmuch as truck operating costs a mile decline as road standards improve, this factor results in

lower wood-transportation costs. Timber truck haul on mainline roads would be cheaper with the Study 5 system than with the Study 4 roads.

Public travel on Highway 37

The road systems of Studies 4 and 5 would attract traffic to different degrees. Because Study 5 offers a paved road along the reservoir face, it would presumably attract many more tourists and recreationists. These differences cannot readily be taken into account. Therefore, table 111 has been prepared indicating the relative economy of public travel in Studies 4 and 5, assuming the same number of vehicles would be involved in each case. The public traffic estimates for Study 4 are used in each case. It is assumed also that the public traffic at the northern terminus of Highway 37 in Study 4 would split in the same proportions as in Studies 1 and 2.

Table 111 shows that annual public travel costs on State Highway 37 in Study 5 would be $63,308 greater than the Study 0 costs. On the other hand, annual public travel costs on the Highway in Study 4 would be $56,037 less than in Study 0. The cost advantage of the Study 4 highway route, as compared to the Study 5 route, is $119,345 annually.

Highway maintenance costs vs. revenue

As in the transportation planning report of Studies 1, 2, and 3, the comparison of public travel costs under Studies 4 and 5 is not complete without considering the effect of whatever part of the increased maintenance costs of the two highway relocation routes is defrayed by an increase in motor fuel tax revenue. Table 112 summarizes the estimated motor fuel tax revenue under each study, using the estimated traffic volumes under each, and compares it to the estimated highway maintenance costs.

Table 112 shows that the State Highway 37 route of Study 5 would have an annual maintenance vs. revenue deficiency $5446 greater than if the highway remained in its present location. The State Highway 37 route of Study 4, on the other hand, shows a decreased maintenance vs. revenue deficiency, as compared to Study 0 of $11,230.

Forest Service administration and protection travel

The summary of administration and protection travel in table 110 does not include travel outside the limits of the planned road restorations and is consequently lower than the corresponding travel figures of Studies 1, 2, and 3. As in the case of the lower dam site, the shorter travel distances and more advantageous location of the higher standard roads tend to make Forest Service travel cheaper with the Study 5 road plan than with the Study 4 plan. The advantage in favor of Study 5 is $6395 a year.

Total annual road and transportation costs

Although the total annual road and transportation costs are indicative of the cost impact of the respective transportation systems, no

Table 111. Comparison of public travel costs via relocation of State Highway 37

Studies 0, 4 and 5

	Miles	Through vehicles per year	Vehicle miles	Cost per vehicle mile	Annual costs: Study 0	Annual costs: Study 4	Annual costs: Study 5
				- - - - - -	Dollars	- - - - - -	
Study 0							
State Highway 37							
Recreational traffic	63.4	47,500	3,011,500	0.104	313,196		
Commercial traffic	63.4	27,500	1,743,500	0.154	268,499		
Eureka to end of project location of Study 4							
Recreational traffic 1/2 (47,500)	14.9	23,750	353,875	0.104	36,803		
Commercial traffic 1/3 (27,500)	14.9	9,167	136,588	0.154	21,035		
Total	78.3		5,245,463		639,533		
Study 4							
Project location							
Recreational traffic	42.3	47,500	2,009,250	0.104		208,962	
Commercial traffic	42.3	27,500	1,163,250	0.154		179,141	
Libby to beginning of project location							
Recreational traffic	12.7	47,500	603,250	0.104		62,738	
Commercial traffic	12.7	27,500	349,250	0.154		53,785	
End of project location to Eureka							
Recreational traffic 1/2 (47,500)	14.9	23,750	353,875	0.104		36,803	
Commercial traffic 2/3 (27,500)	14.9	18,333	273,162	0.154		42,067	
Total	69.9		4,752,037			583,496	
Study 5							
Project location							
Recreational traffic	57.6	47,500	2,736,000	0.104			284,544
Commercial traffic	57.6	27,500	1,584,000	0.154			243,936
Libby to beginning of project location							
Recreational traffic	12.7	47,500	603,250	0.104			62,738
Commercial traffic	12.7	27,500	349,250	0.154			53,785
Eureka to end of project location of Study 4							
Recreational traffic 1/2 (47,500)	14.9	23,750	353,875	0.104			36,803
Commercial traffic 1/3 (27,500)	14.9	9,167	136,588	0.154			21,035
Total	85.2		5,762,963				702,841
Increase or decrease from public travel costs of Study 0						-56,037	+63,308

Table 112. Maintenance costs vs. revenue on State Highway 37

Studies 0, 4, and 5

	Timber haul				Public and Forest Service travel					
	Thousand bd. ft.-miles	Total truck miles 1/	Fuel at 2.9 miles a gallon	Fuel tax revenue at 6¢ a gallon	Vehicle miles	Fuel tax revenue 2/	Total revenue	Estimated maintenance cost	Relative deficiency maintenance cost vs. revenue	Increase or decrease from Study 0 deficiency
			Gallons	Dollars		- - -	- - -	--Dollars--	- - -	- - -
Study 0	187,047	57,552	19,846	1,191	3,586,855	14,347	15,538	46,740	31,202	-
Study 4										
Project location	87,918	27,052	9,328	560	3,422,950	13,692	14,252	34,320		
Unaffected location	-	-	-	-	2,159,000	8,636	8,636	8,540		
Total							22,888	42,860	19,972	-11,230
Study 5										
Project location	181,807	55,941	19,290	1,157	6,877,250	27,509	28,666	65,410		
Unaffected location	-	-	-	-	2,159,000	8,636	8,636	8,540		
Total							37,302	73,950	36,648	+ 5,446

1/ Total truck miles are obtained from dividing the thousand-board-foot miles by 6.5 (assuming 6500 board feet a truck) and multiplying by 2 to convert loaded truck miles to total roundtrip miles.

2/ The fuel tax revenue of 0.4 cents a vehicle mile is based on the state gasoline tax of 6 cents a gallon, assuming an average consumption rate of 15 miles a gallon.

conclusions can be drawn without considering the effect of the road systems on the other cost elements of the protection and utilization phases with which the Libby dam planning project is concerned. The final and complete summary of the cost impact is given in the main report and is not repeated here. However, there are certain significant transportation features which should be mentioned here.

The Study 5 road system has all the advantages of the Study 3 system so far as reduction in wood-procurement and Forest Service administration costs is concerned. With the reservoir bridge crossing, the much desired rapid maneuverability of men, equipment, and supplies from one side of the reservoir to the other is provided. The same bridge crossing connecting with a west-side highway provides the flexibility of transportation which is most important to timber operations. In addition, the Study 5 transportation system provides a satisfactory outlet to Eureka for the Tooley Lake families.

The Study 4 transportation system offers the advantage of lower construction cost. The total investment for all transportation facilities would be almost 6 million dollars lower than Study 5. In addition, the highway maintenance costs not offset by fuel tax revenues would be \$16,676 a year lower than in Study 5; public travel costs \$119,345.

APPENDIX G. WOOD PROCUREMENT, DAM SITE 217.0

The wood-procurement cost data presented in this section are for the same general area as those for Dam Site 204.9 in Appendix C. However, because a smaller part of the Zone of Influence would be inundated the annual allowable cut would be somewhat higher than if the dam were at the lower site. The allowable annual cut for Studies 4 and 5 is: sawtimber 60,947 thousand board feet, and cordwood 86,288 cords.

The objectives of the two postdam studies are:

Study 4

To develop a low cost road system which would permit the movement of wood from the vicinity of the reservoir during the winter when extreme drawdown or ice eliminates the reservoir for wood transport.

Study 5

To develop a road system which will best serve all transportation needs and insure maximum flexibility of transportation by providing a bridge crossing near the present town of Rexford.

The cost analyses of Studies 4 and 5 are based on the following assumptions: (1) Location of the dam at River Mile 217.0 with a maximum reservoir height of 2459 feet above sea level. (2) relocation of the railroad from the mouth of Fisher River, up Fisher River, up Wolf Creek, and down Fortine Creek to a point near Stryker, there connecting with the present main line. (3) All costs and values based on December 31, 1951 rates. (4) All of the timber in the Zone of Influence hauled to Libby for manufacture. (5) the private road tapping the Fisher River drainage available for hauling timber of all ownerships with no differential against timber not owned by the J. Neils Lumber Company. (6) A pulpmill established in or near Libby.

Figure 64 shows how the timber from all parts of the Zone of Influence would be moved to Libby. The only difference in mode of transport (not route) would be that the winter logs from the northwest corner of the Zone of Influence would be moved all the way to Libby by truck in Study 4 and hauled across the reservoir to the railroad at Eureka in Study 5. With the transportation systems of both Studies 4 and 5 it would be necessary to rely more heavily on truck transportation than would be the case in Studies 2 and 3. This is because water transportation offers smaller economy of timber haul at the upper site and because less timber is available to the reservoir. Tables 113 and 114 summarize the sawlog-procurement costs by logging unit groups. Tables 115 to 118, inclusive, present the same information for cordwood.

Tables 119 and 120 compare wood-procurement costs (stump to mill) for Studies 0, 1, 2, 3, 4, and 5. By way of summary the following points are worth noting.

1. The transportation systems of Studies 2 and 3 would have a relatively small effect on wood-procurement costs for the Zone of Influence as a whole. In fact, the Study 3 plan would actually make wood procurement a bit easier. On the other hand annual wood-procurement costs would increase substantially above the Study 0 level if the dam were built at the upper location; $31,000 a year in Study 5, $48,000 a year in Study 4.

2. Building a dam at River Mile 217.0 would, however, benefit the Fisher River subzone. There would be no flowage to disrupt the existing road network and that area would be aided by the relocation of the railroad through it. Table 120 shows, for example, that saw-log-procurement costs in the Fisher River subzone are $1 a thousand board feet cheaper in Studies 4 and 5 than in Study 0. The bulk of the timber in the Fisher River subzone is privately owned.

3. The adverse effect of the 217.0 dam site upon wood-procurement costs is entirely within the Kootenai River subzone. For example, sawlog-procurement costs from this subzone in Study 5 are $2.08 higher a thousand board feet than the costs in Study 0, and $0.80 higher than the Study 3 costs. Most of the timber in the Kootenai River subzone is national forest.

4. The higher procurement cost of Studies 4 and 5 in the Kootenai River subzone is attributable to three things: less timber would be moved by water than in Studies 2 and 3, that handled by water would be over a shorter distance by water, and the water-hauled timber would be trucked 12 miles farther after leaving the load-out point.

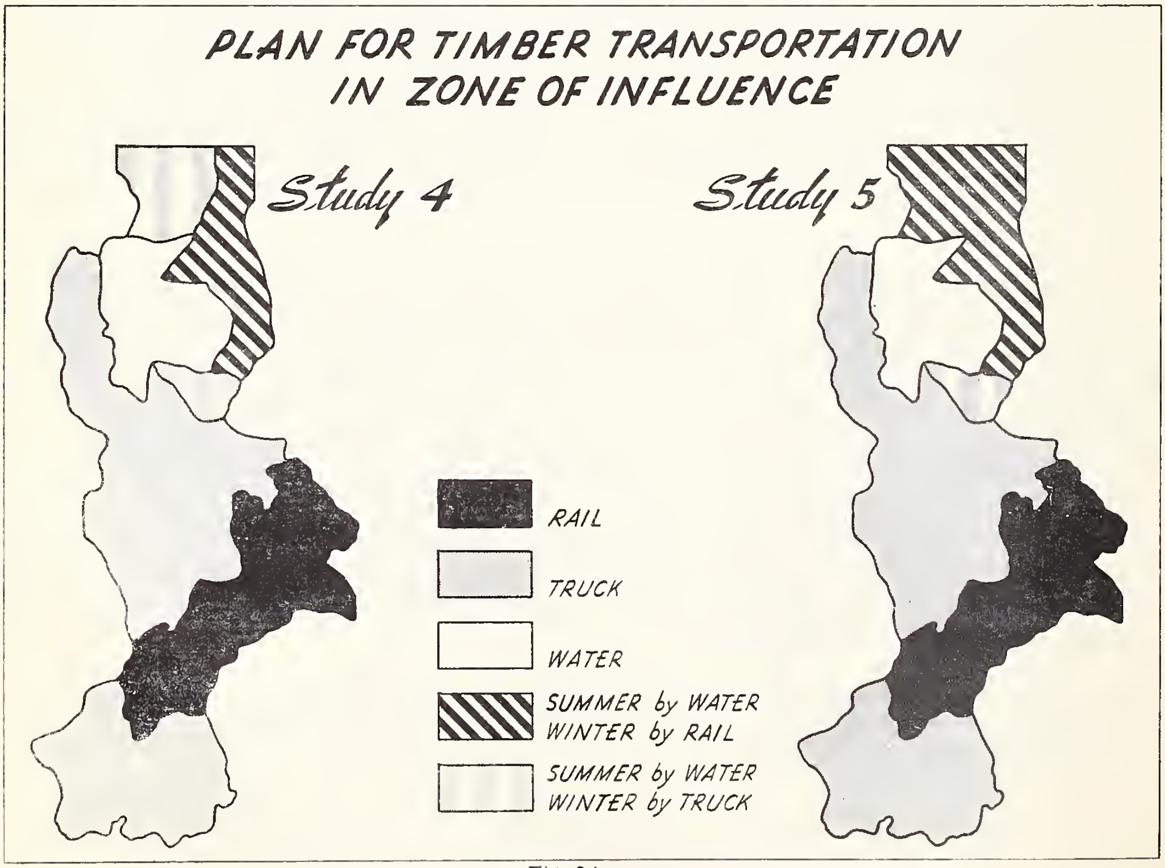


Fig. 64

Table 113. Cost of sawlog production within Zone of Influence--stump to mill

Study 4

Item	Logging unit group: Libby	Warland	Stone-hill	Rex-ford	Libby-Big Creek	Average Kootenai River subzone
	- - - - Dollars per thousand board feet - - - - -					
Roads and camps	2.05	1.67	3.30	1.90	1.07	1.98
Logging	21.55	22.25	22.60	20.94	22.63	21.85
Truck haul to water	-	.22	3.13	1.95	-	1.14
Unload and bundle	-	.04	.39	.20	-	.13
Raft and tow	-	.03	.61	.41	-	.23
Lift and load	-	.06	.57	.30	-	.21
Truck haul dam to Libby	-	.48	4.22	3.20	-	1.72
Maintenance water facilities	-	.12	.84	.54	-	.32
Truck haul stump to Libby	4.90	8.00	-	2.84	9.61	5.05
Truck haul to rail	-	-	-	2.20	-	.59
Reload	-	-	-	.60	-	.16
Freight	-	-	-	1.79	-	.48
Capital cost water facilities1/	-	.14	1.30	.66	-	.44
Subtotal	28.50	33.01	36.96	37.53	33.31	34.30
Capital cost water facilities2/	-	.30	2.71	1.39	-	.93
Total	28.50	33.31	39.67	38.92	33.31	35.23

Item	Logging unit group: Lower Fisher	Mid-Fisher	Wolf Creek	Upper Fisher	Average Fisher River subzone	Average Zone of Influence3/
	- - - - Dollars per thousand board feet - - - - -					
Roads and camps	2.32	2.42	1.12	1.46	1.58	1.80
Logging	21.28	20.59	20.27	20.31	20.44	21.20
Truck haul to water	-	-	-	-	-	.62
Unload and bundle	-	-	-	-	-	.07
Raft and tow	-	-	-	-	-	.12
Lift and load	-	-	-	-	-	.11
Truck haul dam to Libby	-	-	-	-	-	.94
Maintenance water facilities	-	-	-	-	-	.19
Truck haul stump to Libby	5.30	-	-	8.62	3.89	4.49
Truck haul to rail	-	2.84	2.37	-	1.27	.90
Reload	-	1.60	1.60	-	.81	.46
Freight	-	3.15	3.48	-	1.72	1.05
Capital cost water facilities1/	-	-	-	-	-	.24
Subtotal	28.90	30.60	28.84	30.39	29.71	32.19
Capital cost water facilities2/	-	-	-	-	-	.50
Total	28.90	30.60	28.84	30.39	29.71	32.69

1/Cost against timber. 2/Cost against dam project. 3/Based on annual cut 60,947,000 board feet.

Table 114. Cost of sawlog production within Zone of Influence--stump to mill

Study 5

Item	Libby	Warland	Stone-hill	Rex-ford	Libby-Big Creek	Average Kootenai River subzone
	Logging unit group					
	- - - - Dollars per thousand board feet - - - - -					
Roads and camps	2.05	1.67	3.30	1.89	1.07	1.98
Logging	21.55	22.25	22.60	20.94	22.63	21.84
Truck haul to water	-	.22	3.13	1.93	-	1.14
Unload and bundle	-	.04	.39	.20	-	.13
Raft and tow	-	.03	.61	.41	-	.23
Lift and load	-	.06	.57	.29	-	.20
Truck haul dam to Libby	-	.48	4.22	3.21	-	1.72
Maintenance water facilities	-	.12	.84	.54	-	.32
Truck haul stump to Libby	4.90	7.66	-	-	9.61	4.18
Truck haul to rail	-	-	-	2.85	-	.76
Reload	-	-	-	.77	-	.21
Freight	-	-	-	2.31	-	.62
Capital cost water facilities1/	-	.18	1.62	.82	-	.55
Subtotal	28.50	32.71	37.28	36.16	33.31	33.88
Capital cost water facilities2/	-	.21	1.90	.97	-	.65
Total	28.50	32.92	39.18	37.13	33.31	34.53

Item	Lower Fisher	Mid-Fisher	Wolf Creek	Upper Fisher	Average Fisher River subzone	Average Zone of Influence3/
	Logging unit group					
	- - - - Dollars per thousand board feet - - - - -					
Roads and camps	2.32	2.42	1.12	1.46	1.58	1.80
Logging	21.28	20.59	20.27	20.31	20.44	21.20
Truck haul to water	-	-	-	-	-	.62
Unload and bundle	-	-	-	-	-	.07
Raft and tow	-	-	-	-	-	.12
Lift and load	-	-	-	-	-	.11
Truck haul dam to Libby	-	-	-	-	-	.94
Maintenance water facilities	-	-	-	-	-	.19
Truck haul stump to Libby	5.30	-	-	8.62	3.89	4.05
Truck haul to rail	-	2.84	2.37	-	1.27	1.00
Reload	-	1.60	1.60	-	.81	.49
Freight	-	3.15	3.48	-	1.72	1.13
Capital cost water facilities1/	-	-	-	-	-	.30
Subtotal	28.90	30.60	28.84	30.39	29.71	32.02
Capital cost water facilities2/	-	-	-	-	-	.35
Total	28.90	30.60	28.84	30.39	29.71	32.37

1/Cost against timber. 2/Cost against dam project. 3/Based on annual cut 60,947,000 board feet.

Table 115. Cost of cordwood production from thinnings within Zone of Influence--stump to mill

Study 4

Item	Logging unit group: Libby	Warland	Stone-hill	Rex-ford	Libby-Big Creek	Average Kootenai River subzone
	Dollars per cord					
Roads and camps	1.90	1.50	2.17	2.10	1.50	1.77
Logging	8.70	8.70	8.70	8.70	8.70	8.70
Truck haul to water	-	.30	2.50	1.10	-	.77
Unload and bundle	-	.10	.27	.16	-	.12
Raft and tow	-	.05	.08	.09	-	.05
Lift and load	-	.12	.35	.20	-	.14
Truck haul dam to Libby	-	.50	2.10	1.40	-	.82
Maintenance water facilities	-	.18	.41	.20	-	.18
Truck haul stump to Libby	-	3.50	-	.73	6.00	2.09
Truck haul to rail	3.35	-	-	1.80	-	.85
Reload	-	-	-	.30	-	.05
Freight	-	-	-	1.18	-	.22
Capital cost water facilities[1]	-	-	-	-	-	-
Total	13.95	14.95	16.58	17.96	16.20	15.76

Item	Logging unit group: Lower Fisher	Mid-Fisher	Wolf Creek	Upper Fisher	Average Fisher River subzone	Average Zone of Influence[2]
	Dollars per cord					
Roads and camps	1.20	1.50	1.88	1.66	1.68	1.74
Logging	8.70	8.70	8.70	8.70	8.70	8.70
Truck haul to water	-	-	-	-	-	.52
Unload and bundle	-	-	-	-	-	.06
Raft and tow	-	-	-	-	-	.03
Lift and load	-	-	-	-	-	.09
Truck haul dam to Libby	-	-	-	-	-	.50
Maintenance water facilities	-	-	-	-	-	.10
Truck haul stump to Libby	4.00	5.00	-	4.65	2.55	2.26
Truck haul to rail	-	-	1.40	-	.62	.77
Reload	-	-	.60	-	.27	.13
Freight	-	-	2.80	-	1.24	.60
Capital cost water facilities[1]	-	-	-	-	-	-
Total	13.90	15.20	15.38	15.01	15.06	15.50

1/No water facilities charged to cordwood.
2/Total annual production 46,501 cords.

Table 116. Cost of cordwood production from thinnings within Zone of Influence--stump to mill

Study 5

Item	Libby	Warland	Stone-hill	Rex-ford	Libby-Big Creek	Average Kootenai River subzone
	Logging unit group					
	Dollars per cord					
Roads and camps	1.90	1.50	2.17	2.11	1.50	1.77
Logging	8.70	8.70	8.70	8.70	8.70	8.70
Truck haul to water	-	.30	2.50	1.00	-	.77
Unload and bundle	-	.10	.27	.16	-	.11
Raft and tow	-	.05	.08	.10	-	.05
Lift and load	-	.12	.35	.20	-	.14
Truck haul dam to Libby	-	.50	2.10	1.05	-	.76
Maintenance water facilities	-	.18	.41	.16	-	.16
Truck haul stump to Libby	3.35	3.50	-	.23	6.00	2.52
Truck haul to rail	-	-	-	1.78	-	.33
Reload	-	-	-	.30	-	.05
Freight	-	-	-	1.18	-	.22
Capital cost water facilities1/	-	-	-	-	-	-
Total	13.95	14.95	16.58	16.97	16.20	15.58

Item	Lower Fisher	Mid-Fisher	Wolf Creek	Upper Fisher	Average Fisher River subzone	Average Zone of Influence2/
	Logging unit group					
	Dollars per cord					
Roads and camps	1.20	1.50	1.88	1.66	1.68	1.74
Logging	8.70	8.70	8.70	8.70	8.70	8.70
Truck haul to water	-	-	-	-	-	.52
Unload and bundle	-	-	-	-	-	.07
Raft and tow	-	-	-	-	-	.03
Lift and load	-	-	-	-	-	.09
Truck haul dam to Libby	-	-	-	-	-	.48
Maintenance water facilities	-	-	-	-	-	.10
Truck haul stump to Libby	4.00	5.00	-	4.65	2.55	2.41
Truck haul stump to rail	-	-	1.40	-	.62	.43
Reload	-	-	.60	-	.27	.23
Freight	-	-	2.80	-	1.24	.59
Capital cost water facilities1/	-	-	-	-	-	-
Total	13.90	15.20	15.38	15.01	15.06	15.39

1/No water facilities charged to cordwood.
2/Total annual production 46,501 cords.

Table 117. Cost of cordwood production from tops, cull, and understory trees within Zone of Influence--stump to mill

Study 4

Item	Logging unit group: Libby	Warland	Stone-hill	Rex-ford	Libby-Big Creek	Average Kootenai River subzone
	Dollars per cord					
Roads and camps	.10	.10	.10	.10	.10	.10
Logging	5.10	5.05	5.05	5.05	5.05	5.05
Truck haul to water	-	.35	2.73	1.20	-	.84
Unload and bundle	-	.12	.29	.17	-	.12
Raft and tow	-	.06	.09	.10	-	.06
Lift and load	-	.14	.38	.22	-	.20
Truck haul dam to Libby	-	.55	3.70	1.90	-	1.30
Maintenance water facilities	-	.18	.30	.14	-	.12
Truck haul stump to Libby	3.70	4.00	-	.80	6.66	2.80
Truck haul to rail	-	-	-	1.95	-	.52
Reload	-	-	-	.35	-	.09
Freight	-	-	-	1.30	-	.34
Capital cost water facilities1/	-	-	-	-	-	-
Total	8.90	10.55	12.64	13.28	11.81	11.54

Item	Logging unit group: Lower Fisher	Mid-Fisher	Wolf Creek	Upper Fisher	Average Fisher River subzone	Average Zone of Influence2/
	Dollars per cord					
Roads and camps	.10	.10	.10	.10	.10	.10
Logging	5.05	5.05	5.05	5.05	5.05	5.05
Truck haul to water	-	-	-	-	-	.44
Unload and bundle	-	-	-	-	-	.07
Raft and tow	-	-	-	-	-	.03
Lift and load	-	-	-	-	-	.10
Truck haul dam to Libby	-	-	-	-	-	.69
Maintenance water facilities	-	-	-	-	-	.05
Truck haul stump to Libby	4.45	5.68	-	5.07	3.14	2.96
Truck haul to rail	-	-	1.63	-	.62	.57
Reload	-	-	.65	-	.25	.16
Freight	-	-	3.08	-	1.18	.74
Capital cost water facilities1/	-	-	-	-	-	-
Total	9.60	10.83	10.51	10.22	10.34	10.96

1/No water facilities charged to cordwood. 2/Total annual production 39,787 cords.

Table 118. Cost of cordwood production from tops, cull, and understory trees within Zone of Influence--stump to mill

Study 5

Item	Logging unit group: Libby	Warland	Stone-hill	Rex-ford	Libby-Big Creek	Average Kootenai River subzone
	Dollars per cord					
Roads and camps	.10	.10	.10	.10	.10	.10
Logging	5.10	5.05	5.05	5.05	5.05	5.05
Truck haul to water	-	.35	2.73	1.10	-	.84
Unload and bundle	-	.12	.29	.17	-	.12
Raft and tow	-	.06	.09	.10	-	.06
Lift and load	-	.14	.38	.22	-	.20
Truck haul dam to Libby	-	.55	3.70	1.05	-	1.04
Maintenance water facilities	-	.18	.30	.12	-	.11
Truck haul stump to Libby	3.70	4.00	-	.70	6.66	2.78
Truck haul to rail	-	-	-	2.30	-	.61
Reload	-	-	-	.50	-	.11
Freight	-	-	-	1.65	-	.44
Capital cost water facilities[1]	-	-	-	-	-	-
Total	8.90	10.55	12.64	13.06	11.81	11.46

Item	Logging unit group: Lower Fisher	Mid-Fisher	Wolf Creek	Upper Fisher	Average Fisher River subzone	Average Zone of Influence[2]
	Dollars per cord					
Roads and camps	.10	.10	.10	.10	.10	.10
Logging	5.05	5.05	5.05	5.05	5.05	5.05
Truck haul to water	-	-	-	-	-	.44
Unload and bundle	-	-	-	-	-	.07
Raft and tow	-	-	-	-	-	.03
Lift and load	-	-	-	-	-	.10
Truck haul dam to Libby	-	-	-	-	-	.55
Maintenance water facilities	-	-	-	-	-	.06
Truck haul stump to Libby	4.45	5.68	-	5.07	3.14	2.93
Truck haul to rail	-	-	1.63	-	.62	.62
Reload	-	-	.65	-	.25	.19
Freight	-	-	3.08	-	1.18	.79
Capital cost water facilities[1]	-	-	-	-	-	-
Total	9.60	10.83	10.51	10.22	10.34	10.93

1/No water facilities charged to cordwood. 2/Total annual production 39,787 cords.

Table 119. Cost of wood procurement in the Zone of Influence based on the total allowable cut[1]

Studies 1, 2, 3, 4, and 5

	Sawtimber	Cordwood		
	Per thousand board feet	Thinnings	Tops and cull	All
	Dollars	- - - Dollars per cord - - -		
No dam				
Study 0	31.34	15.61	10.93	13.45
Dam at River Mile 204.9				
Study 1	33.62	16.30	11.37	14.02
Study 2	31.66	15.27	10.51	13.07
Study 3	31.47	15.06	10.41	12.91
Dam at River Mile 217.0				
Study 4	32.19	15.50	10.96	13.41
Study 5	32.02	15.39	10.93	13.33

1/Not including water facilities charged to dam project. Including cost of seasonal operation in Study 1.

Table 120. Summary of wood-procurement costs, per unit of wood, Kootenai River and Fisher River subzones[1]

Studies 0, 1, 2, 3, 4, and 5

	No dam	Dam Site 204.9			Dam Site 217.0	
	Study	Study			Study	
	0	1	2	3	4	5
	- - - Dollars per thousand board feet - - -					
Sawlogs						
Kootenai River	31.80	34.08	33.04	33.08	34.30	33.88
Fisher River	30.80	30.22	29.92	29.93	29.71	29.71
Entire Zone	31.34	32.34	31.66	31.47	32.19	32.02
	- - - - - - Dollars per cord - - - - - - - -					
Cordwood						
Kootenai River	13.49	13.47	13.29	13.05	13.97	13.83
Fisher River	13.39	13.43	12.75	12.73	12.36	12.36
Entire zone	13.45	13.45	13.07	12.91	13.41	13.33

1/Not including water facilities charged to dam project. Not including cost of seasonal operation in Study 1.

A dam at River Mile 217.0 would have almost as great an impact upon national forest administration as one at River Mile 204.9. The same ranger stations and work centers would be flooded. Transportation and communications near the south end of the Kootenai River subzone would be simpler but the reservoir would be just as much of a barrier to transportation at the north end of the county.

Replacement of ranger stations

In both Studies 4 and 5 the Warland and Rexford ranger stations and their associated work centers would have to be replaced. The replacement value of these stations is estimated in detail in tables 83 and 85. Study 4 proposes moving the Rexford ranger district headquarters to Eureka and the work center of that district to Sutton Creek. The Warland headquarters station would be moved to Dunn Creek and the Warland district work center to Warland Creek. Study 4 has the travel disadvantages of Study 2, hence an additional ranger station would be needed in this case also. It is planned that such headquarters would be established near the middle of the district in Section 32, T34N, R29W, near the north fork of Big Creek. This is not an entirely desirable location, and if used yearlong, would offer quite a snow removal problem. However, it seems to be about as good a location as we can choose from the standpoint of being centrally located for a new district in the northwest section of the zone. It would be on the Big Creek-Pipe Creek road and about 3 miles from the 16-foot road planned to extend along the west side of the flowage from River Mile 217.0 up to Poverty Creek. A detailed estimate of the cost of such a station is contained in table 86.

Study 5 proposes moving the Rexford district headquarters to Eureka and the work center to Big Creek. The Warland district headquarters would be located at Libby and the work center at Wolf Creek. Table 121 summarizes the ranger station replacement costs in Studies 4 and 5.

Replacement of communications

The replacement for the existing metallic telephone line between Libby and Eureka would in the main follow the new route of Highway 37. Thus, because the Study 4 highway route is considerably shorter than the Study 2 route, the communications replacement job is substantially smaller for Study 4 than for Study 2.

Table 121. Cost of replacing ranger station and work center facilities, Dam Site 217.0

Studies 4 and 5

Ranger district	District headquarters	Work center	Total
	- - - - - Dollars	- - - - -	
Warland	112,789	34,947	147,636
Rexford	85,175	41,783	126,958
New	128,041	-	128,041
Total Study 4	-	-	402,635
Total Study 5	-	-	274,594

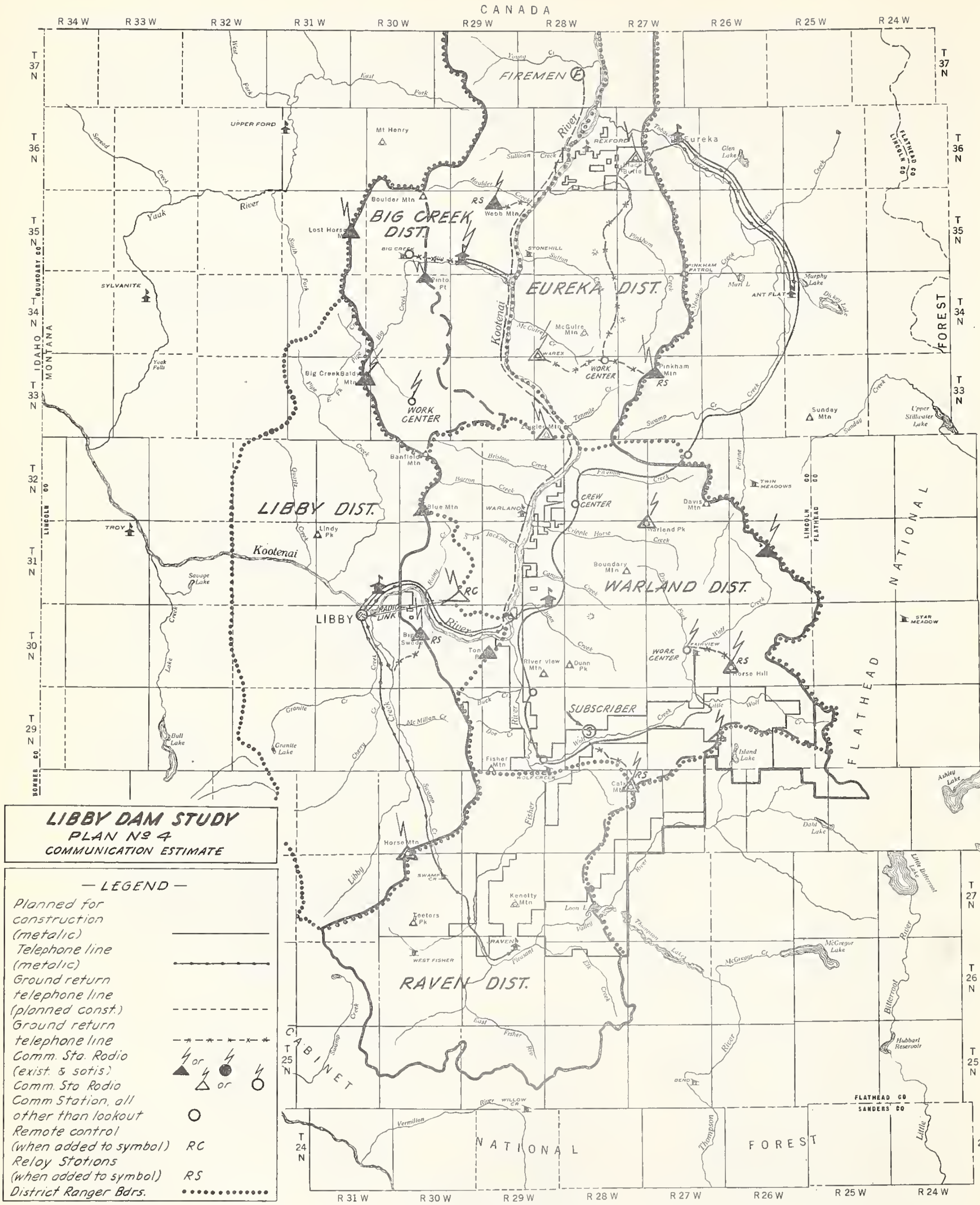

CANADA
LIBBY DAM STUDY
PLAN Nº 4
COMMUNICATION ESTIMATE
— LEGEND —
Planned for construction (metalic)
Telephone line (metalic)
Ground return telephone line (planned const.)
Ground return telephone line
Comm. Sta. Radio (exist. & satis.)
Comm. Sta Radio
Comm Station, all other than lookout
Remote control (when added to symbol) RC
Relay Stations (when added to symbol) RS
District Ranger Bdrs.
BIG CREEK DIST.
EUREKA DIST.
LIBBY DIST.
WARLAND DIST.
RAVEN DIST.
LIBBY
FLATHEAD NATIONAL FOREST
CABINET NATIONAL FOREST

Figure 65

The relocation of this line would follow about the same course in Studies 3 and 5. However, less line would be inundated in the latter case. Therefore, the replacement cost would be lower. The following is the total cost of restoring communication facilities in each case: Study 2, $377,000; Study 3, $315,000; Study 4, $257,000; and Study 5, $250,000.

Figure 65 shows the communications facilities which would be required for Study 4 and table 122 summarizes the cost of these replacements. The same data for Study 5 are presented in figure 66 and table 123.

Table 122. Cost of restoring communication facilities

Study 4

Item	Quantity	Cost
	Miles	Dollars
Telephone line		
Libby-Eureka	61	142,025
Eureka-Pinkham Creek	6	6,200
Libby-Big Creek Ranger Station	52	43,800
Big Creek Ranger Station-Tooley Lake	22	17,000
Warland Ranger Station-Fairview	38	19,000
Subtotal	179	228,025
Removal of old telephone line[1]	78	2,400
Radio (15 sets)		12,620
Removal and installation of Rexford equipment		250
Remote control for Libby Ranger Station		5,000
Power plants for Big Creek and Warland Ranger Stations		9,000
Total		257,295

1/No charge made for line removal in flowage area since it is supposed that this will be taken care of when the area is cleared.

Table 122 supplement. Detailed estimate of costs of restoring communication facilities

Study 4

	Dollars
Libby-Eureka telephone line	
Metallic circuit bracket line, 46 miles at $2500 a mile	115,000
Metallic circuit on poles of Eureka-Ant Flat line, 15 miles at $500 a mile	7,500
Cable crossing on Libby dam. Plans for dam must include placement of conduit to accommodate telephone cable.	1,000
Construction costs added for surveys, office drafting, supervision and overhead (15 percent)	18,525
Total	142,025
Eureka District	
Telephone	
Construction. Eureka to junction with Pinkham line.	
Metallic bracket line, 2 miles at $2500 a mile	5,000
Ground return circuit, 4 miles at $300 a mile	1,200
Line removal (abandoned lines)	
Metallic, Rexford to Eureka, 9 miles at $75 a mile	675
Ground return circuit, Rexford to Black Butte spur, 4 miles at $25 a mile	100
Radio	
Removal and installation of radio equipment from Rexford to Eureka; material $150, labor $100	250
Warex Lookout. This is a primary lookout for fire control during clearing operations in flowage area. FM backpack radio $440, antenna and material $50, labor and travel $50	540
Prevention guard. Radio, FM mobile. For use by fire guard in flowage area.	750
Tanker (fire). Radio, FM backpack and mobile antenna	465
Big Creek District	
Telephone	
Telephone circuit from Libby to Big Creek Ranger Station	
Metallic circuit on poles of the Libby-Eureka telephone line, 15 miles at $500 a mile	7,500
Metallic circuit bracket line, 2 miles at $2500 a mile	5,000
Ground return circuit from Libby dam to mouth of Big Creek, 31 miles: 10 miles pole line at $1500 a mile; and 21 miles tree line at $300 a mile	21,300
Metallic circuit bracket line, 4 miles at $2500 a mile	10,000

Table 122 supplement. Detailed estimate of costs of restoring communication facilities (Cont.)

Study 4

	Dollars
Big Creek District (Cont.)	
Telephone (Cont.)	
Telephone circuit from Big Creek Ranger Station to Tooley Lake. Metallic circuit on poles of Libby-Big Creek line, 4 miles at $500 a mile	2,000
Ground return circuit from Big Creek to Tooley Lake, 18 miles: 8 miles pole line at $1500 a mile; 10 miles tree line at $300 a mile	15,000
Radio	
Big Creek Ranger Station. A 10 kw diesel electric plant would be needed at the Big Creek Ranger Station to furnish power for all purposes. Such a plant, complete with controls, storage tank, pipe and wiring, would cost $4500. The smallest diesel plant available (3 kw) which would be sufficient for radio power would cost $1500. This amount should be charged against communication and the remaining $3000 against other uses. Central station FM 50 watts $1760, antenna and material $300, labor $50, power plant $4500	6,610
Ziegler Mountain Lookout. Relay set FM lookout $850, antennas (2) and material $100, labor $100	1,050
Prevention guard. Radio, FM mobile. For use by fire guard in flowage area.	750
Tanker (fire). Radio, FM backpack and mobile antenna	465
Maintenance and fire crew. Radio, FM backpack	450
Warland District	
Telephone	
Construction. Metallic circuit from Warland Ranger Station to Fairview station. Poles of Libby-Eureka line 3 miles, poles of Great Northern Railway 35 miles--38 miles at $500 a mile	19,000
Line removal. Ground return, Warland to Point 15, 21 miles at $25 a mile	525
Ground return, Ziegler Mountain to Bristow Creek, 4 miles at $25 a mile	100
Ground return, Warland to Warland Peak, 21 miles at $25 a mile	525
Ground return, Wolf Creek Station to Fairview, 19 miles at $25 a mile	475

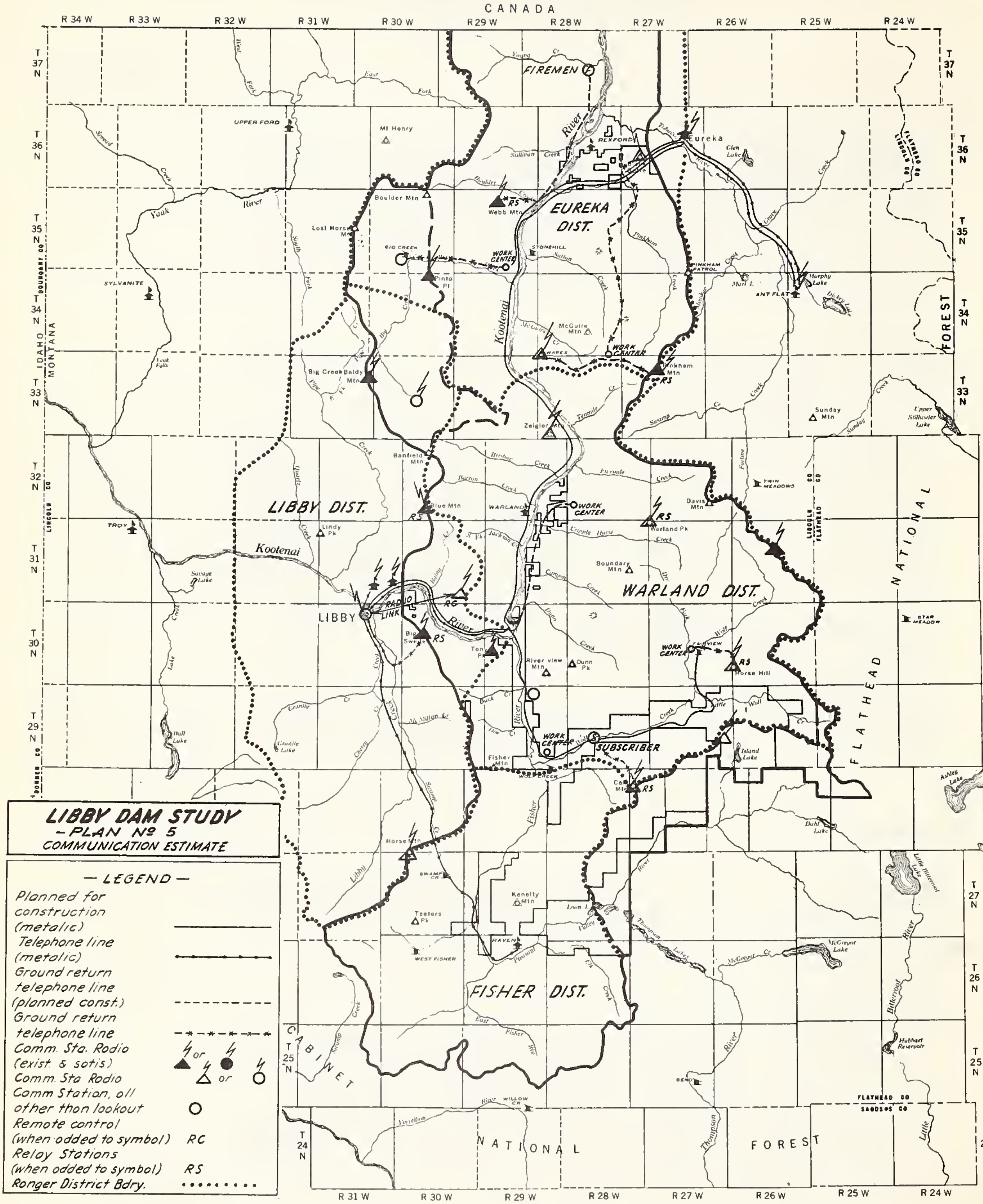

LIBBY DAM STUDY
-PLAN Nº 5
COMMUNICATION ESTIMATE
— LEGEND —
Planned for construction (metalic)
Telephone line (metalic)
Ground return telephone line (planned const.)
Ground return telephone line
Comm. Sta. Radio (exist. & satis.)
or
Comm. Sta Radio
or
Comm Station, all other than lookout
Remote control (when added to symbol) RC
Relay Stations (when added to symbol) RS
Ranger District Bdry.
CANADA
R 34 W
R 33 W
R 32 W
R 31 W
R 30 W
R 29 W
R 28 W
R 27 W
R 26 W
R 25 W
R 24 W
T 37 N
T 36 N
T 35 N
T 34 N
T 33 N
T 32 N
T 31 N
T 30 N
T 29 N
T 28 N
T 27 N
T 26 N
T 25 N
T 24 N
IDAHO
MONTANA
FIREMEN
EUREKA DIST.
LIBBY DIST.
WARLAND DIST.
FISHER DIST.
Eureka
REXFORD
Kootenai
River
LIBBY
RADIO LINK
RS
RC
WORK CENTER
SUBSCRIBER
Boulder Mtn
Webb Mtn
Pinto Pt
Big Creek Baldy Mtn
Zeigler Mtn
Banfield Mtn
Blue Mtn
Lindy Pk
Big Swede
Horse Mtn
Teeters Pk
Kenelty Mtn
McGuire Mtn
Pinkham Mtn
Davis Mtn
Warland Pk
Boundary Mtn
Horse Hill
River view Mtn
Dunn Pk
Fisher Mtn
Sunday Mtn
Mt Henry
TROY
SYLVANITE
UPPER FORD
WARLAND
TWIN MEADOWS
STAR MEADOW
PINKHAM PATROL
ANT FLAT
Murphy Lake
Glen Lake
Island Lake
Dahl Lake
McGregor Lake
Ashley Lake
Upper Stillwater Lake
Hubbart Reservoir
FLATHEAD
NATIONAL
FOREST
CABINET
NATIONAL FOREST

Figure 66

Table 122 supplement. Detailed estimate of costs of restoring communication facilities (Cont.)

Study 4

	Dollars
Warland District (Cont.)	
Radio	
Warland Ranger Station. Central station, FM 50 watts \$1760, antenna and material \$300, labor \$50, power plant (10 kw diesel) \$4500	6,610
Warland Peak Lookout. Relay set FM lookout \$850, antennas and material \$100, labor \$100	1,050
Prevention guard. Radio, FM mobile. For use of fire guard in flowage area.	750
Tanker (fire). Radio, FM backpack and mobile antenna	465
Maintenance and fire crew. Radio, FM backpack	450
Libby District	
Radio	
Remote control. Remote control station on Zonolite Ridge. This installation is essential if adequate radio coverage is to be secured over the flowage area for fire control purposes during the construction period. The central station is now located at the Libby Ranger Station. Radio link 400 mc \$3000; cement block shelter 8' x 10', \$1000; antennas (5) \$500; material \$350; labor \$150	5,000
Prevention guard. Radio, FM mobile. For use by fire guard in flowage area.	750
Tanker (fire). Radio, FM backpack and mobile antenna	465

Table 123. Cost of restoring communication facilities

Study 5

Item	Quantity	Cost
	Miles	Dollars
Telephone line		
Libby-Eureka	53	162,725
Eureka-Pinkham Creek	6	3,000
Eureka-Big Creek-Tooley Lake	33	22,300
Libby-Warland-Fairview	62	44,800
Subtotal	154	232,825
Removal of old telephone line[1/]	57	1,875
Radio (12 sets)		9,785
Removal and installation of Rexford equipment		250
Remote control for Libby Ranger Station		5,000
Total		249,735

1/No charge made for line removal in flowage since it is supposed that this will be taken care of when the area is cleared.

Table 123 supplement. Detailed estimate of costs of restoring communication facilities

Study 5

	Dollars
Libby-Eureka telephone line	
Metallic circuit, 53 miles: 6 miles crossarm construction at $3000 a mile and 47 miles bracket construction at $2500 a mile	141,500
Construction costs added for surveys, office drafting, supervision, and overhead (15 percent)	21,225
Total	162,725
Eureka District	
Telephone	
Construction. Eureka to junction with Pinkham line.	
Metallic circuit on poles of Libby-Eureka line, 6 miles at $500 a mile	3,000
Eureka-Big Creek Tooley Lake line. Metallic circuit on poles of Libby-Eureka line, 20 miles at $500 a mile	10,000
Ground return circuit pole line, 7 miles at $1500 a mile	10,500
Ground return circuit tree line, 6 miles at $300 a mile	1,800
Line removal (abandoned lines)	
Metallic, Rexford to Eureka, 9 miles at $75 a mile	675
Ground return circuit, Rexford to Black Butte spur, 4 miles at $25 a mile	100
Radio	
Removal and installation of radio equipment	
Rexford to Eureka; material $150, labor $100	250
Warex Lookout. This is a primary lookout fir fire control during clearing operations in flowage area. FM backpack radio $440, antenna and material $50, labor and travel $50	540
Prevention guard. Radio, FM mobile. For use by fire guard in flowage area	750
Tanker (fire). Radio, FM backpack and mobile antenna	465
Warland District	
Telephone. Plans for dam must include placement of conduit to accommodate telephone lines.	
Construction. Libby-Warland Creek-Fairview metallic circuit line. Poles of Libby-Eureka line 15 miles, poles of Great Northern Railway 30 miles--45 miles at $500 a mile	22,500
Metallic circuit bracket construction, 3 miles at $2500 a mile	7,500
Cable crossing on Libby dam	1,000
Ground return circuit pole line, 8 miles at $1500 a mile	12,000
Ground return circuit tree line, 6 miles at $300 a mile	1,800

Table 123 supplement. Detailed estimate of costs of restoring communication facilities (Cont.)

Study 5

	Dollars
Warland District (Cont.)	
Telephone (Cont.)	
Line removal. Ground return, Warland to Point 15, 21 miles at $25 a mile	525
Ground return, Ziegler Mountain to Bristow, 4 miles at $25 a mile	100
Ground return, Wolf Creek Station to Fairview, 19 miles at $25 a mile	475
Radio	
Warland Ranger Station. Central station for 400 mc link $1760, antenna and material $500, labor $100	2,360
Warland Peak and Ziegler Mountain Lookouts. Relay sets FM lookout $1700, antennas and material $200, labor $200	2,100
Prevention guard. Radio, FM mobile. For use of fire guard in flowage area	750
Tanker (fire). Radio, FM backpack and mobile antenna	465
Maintenance and fire crew. Radio, FM backpack	450
Libby District	
Radio	
Remote control. Remote control station on Zonolite Ridge. This installation is essential if adequate radio coverage is to be secured over the flowage area for fire control purposes during the construction period. The central station is now located at the Libby Ranger Station. Radio link 400 mc $3000, cement block shelter 8' x 10', $1000; antennas (5) $500; material $350; labor $150	5,000
Prevention guard. Radio, FM mobile. For use by fire guard in flowage area.	750
Tanker (fire). Radio, FM backpack and mobile antenna	465
Point 15 work center. Radio, FM backpack $440; antenna, material, and labor $250	690

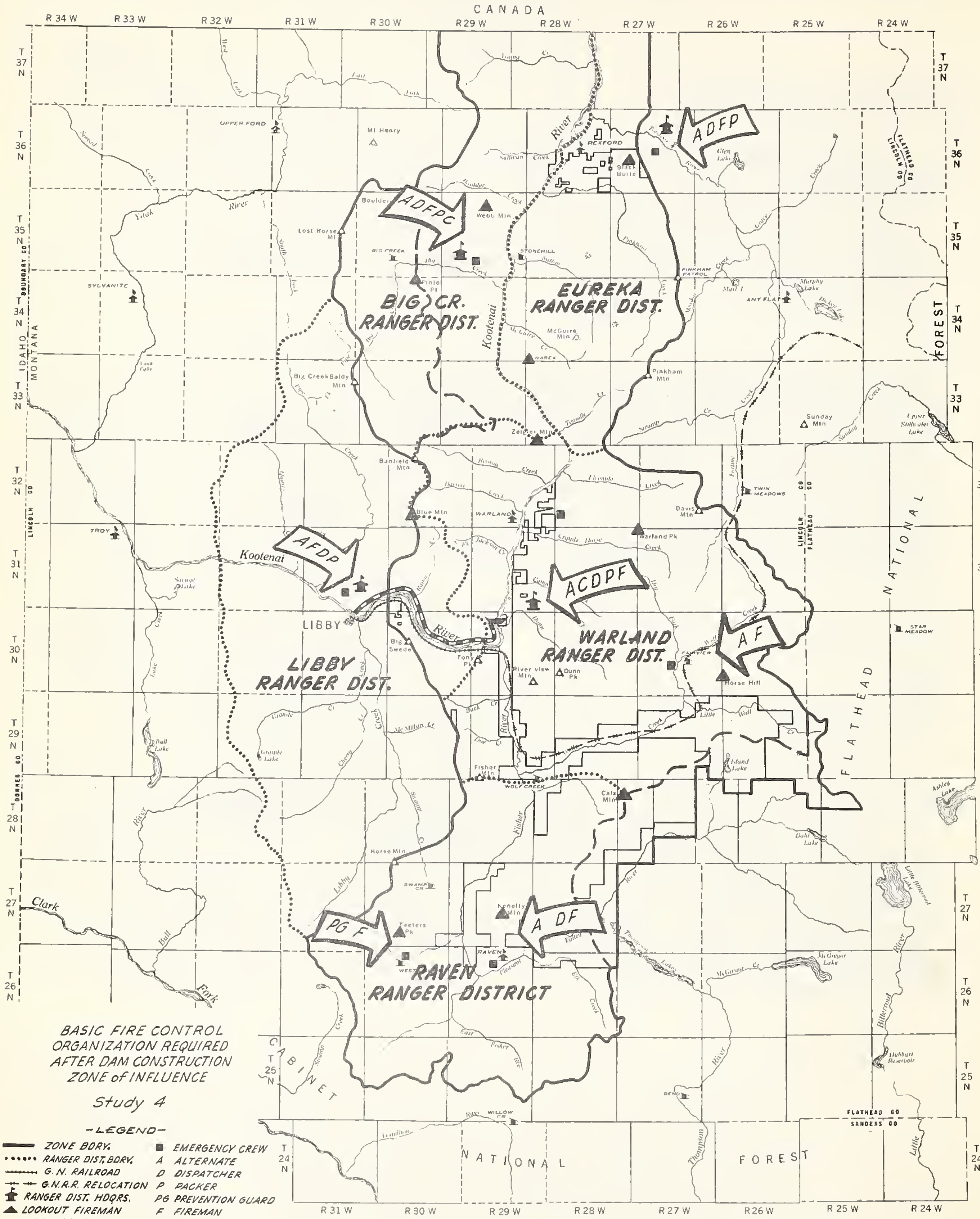

CANADA
R 34 W
R 33 W
R 32 W
R 31 W
R 30 W
R 29 W
R 28 W
R 27 W
R 26 W
R 25 W
R 24 W
T 37 N
T 36 N
T 35 N
T 34 N
T 33 N
T 32 N
T 31 N
T 30 N
T 29 N
T 28 N
T 27 N
T 26 N
T 25 N
T 24 N
IDAHO
MONTANA
ADFP
ADFPC
AFDP
ACDPF
A F
PG F
A DF
BIG CR. RANGER DIST.
EUREKA RANGER DIST.
WARLAND RANGER DIST.
LIBBY RANGER DIST.
RAVEN RANGER DISTRICT
REXFORD
Black Butte
Webb Mtn
Mt Henry
UPPER FORD
Boulder
Lost Horse Mt
SYLVANITE
Big Creek Baldy Mtn
Pinkham Mtn
Sunday Mtn
Zeigler Mtn
Banfield Mtn
Blue Mtn
WARLAND
Davis Mtn
Warland Pk
TROY
Kootenai
River
LIBBY
Big Swede
Tony Pk
River view Mtn
Dunn Pk
Horse Hill
Fisher Mtn
WOLF CREEK
Cal Mtn
Horse Mtn
Kenelly Mtn
Teeters Pk
RAVEN
Sunday
TWIN MEADOWS
STAR MEADOW
Island Lake
McGregor Lake
Ashley Lake
Hubbart Reservoir
CABINET
NATIONAL
FOREST
FLATHEAD
FLATHEAD CO
SANDERS CO
LINCOLN CO
BASIC FIRE CONTROL ORGANIZATION REQUIRED AFTER DAM CONSTRUCTION ZONE of INFLUENCE
Study 4
-LEGEND-
ZONE BDRY.
RANGER DIST. BDRY.
G. N. RAILROAD
G.N.R.R. RELOCATION
RANGER DIST. HDQRS.
LOOKOUT FIREMAN
DAM LOCATION
EMERGENCY CREW
A ALTERNATE
D DISPATCHER
P PACKER
PG PREVENTION GUARD
F FIREMAN
C COOK

Figure 67

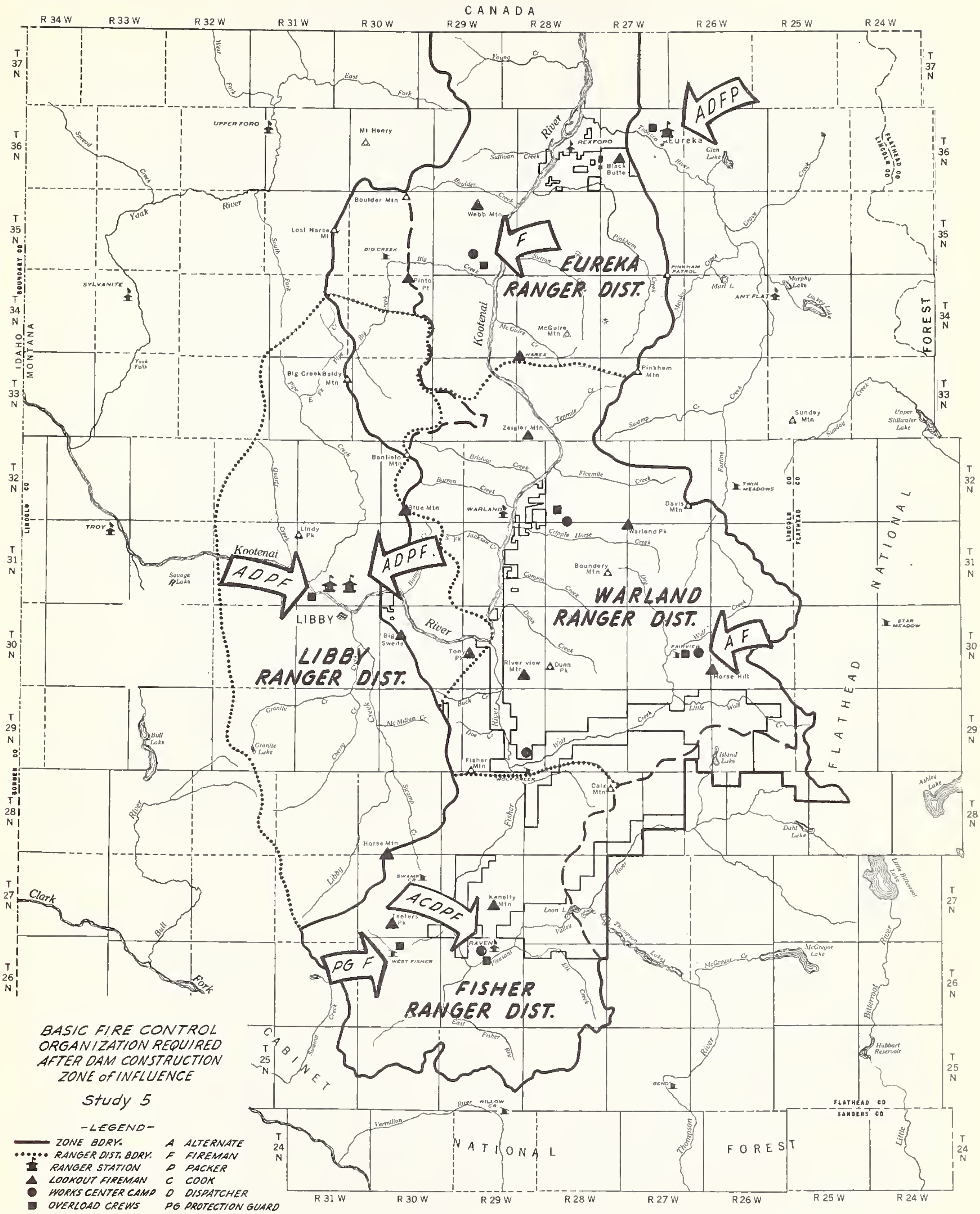

CANADA
EUREKA RANGER DIST.
WARLAND RANGER DIST.
LIBBY RANGER DIST.
FISHER RANGER DIST.
ADFP
F
ADPF
ADPF.
AF
ACDPF
PG F
Eureka
Rexford
Libby
Kootenai
River
IDAHO
MONTANA
FLATHEAD NATIONAL FOREST
CABINET NATIONAL FOREST
BASIC FIRE CONTROL ORGANIZATION REQUIRED AFTER DAM CONSTRUCTION ZONE of INFLUENCE
Study 5
-LEGEND-
ZONE BDRY.
RANGER DIST. BDRY.
RANGER STATION
LOOKOUT FIREMAN
WORKS CENTER CAMP
OVERLOAD CREWS
A ALTERNATE
F FIREMAN
P PACKER
C COOK
D DISPATCHER
PG PROTECTION GUARD

Figure 68

Table 124. Fire control organization plan for the Zone of Influence following the construction of Libby dam

Study 4

POSITIONS					Fire danger	Fire control occupancy					Travel exp.	No. men	Cost normal season
Station	Title	Location				From	To	Pay periods					
		Sec.	Twp.	Rng.				Spring	Summer	Total			
Libby, Sup. Office	F.Disp.	3	30	31		4/10	11/15	6.0	10.0	16.0	75	1	
" " "	T.Driv.					6/1	10/15	2.0	7.5	9.5		2	
" " "	CommAsst					5/15	9/10	3.0	5.0	8.0		3	
" " "	A.Obs.				33	6/16	9/15	1.0	5.5	6.5		4	
" " "	Wheeman					7/1	9/20		6.0	6.0		5	
						Total cost $6,056. Use 50% for Zone							$ 3,065.00
Eureka	R.Alt.	14	36	27		4/21	11/15	5.0	9.0	14.0	25	6	
"	Disp.	"				5/16	9/5	3.0	5.0	8.0	25	7	
"	Packer	"				6/1	10/15	2.0	7.5	9.5		8	
"	F.	"				6/1	10/1	2.0	7.0	9.0	20	9	
Black Butte	L.O.F.	20	36	27		6/16	9/5	1.0	5.0	6.0		10	
Warex Mt.	"	6	33	28		6/26	8/31	.5	5.0	5.5		11	
Eureka	L.O.F.				70	7/6	8/31		4.0	4.0		12	
"	T.D.	14	36	27	73							(1)	
"	Crew	"			80							(6)	9,760.00
						Normal season 51 pay periods at $190+$70 = $9,760.							
						Overload 6 men at $130 = $780.							
Dunn Creek	R.Alt.	34	31	29		4/21	11/5	5.0	9.0	14.0	25	13	
" "	Disp.	"				5/16	9/5	3.0	5.0	8.0	25	14	
" "	Packer	"				6/1	10/15	2.0	7.5	9.5		15	
" "	Fireman	"				6/1	10/1	2.0	7.0	9.0	20	16	
" "	Cook	"				7/1	10/31	.0	4.5	4.5		17	
Fairview	R.Alt.	22	30	27		6/1	9/30	2.0	6.5	8.5		18	
"	F.	"				6/1	9/30	2.0	6.5	8.5		19	
Zeigler Mt.	L.O.F.	31	33	28		6/16	9/5	.5	5.0	5.5		20	
Warland Pk.	L.O.F.	6	31	27		6/26	9/5	.5	5.0	5.5		21	
Horse Hill	L.O.F.	30	30	26		6/16	9/5	1.0	5.0	6.0		22	
Calx Mt.	L.O.F.	10	28	27		6/21	9/5	.5	5.0	5.5		23	15,632.00
Dunn Creek	T.D.	34	31	29	72							(7)	
Warland Cr.	Crew	31	32	28	82							(12)	
Fairview	Crew	22	30	27	80							(17)	
						Normal season 84½ pay periods at $185 + $70 = $15,632							
						Overload 11 men at $130 = 1,430							
Big Creek	R.Alt.	32	35	29		4/21	11/5	5.0	9.0	14.0	25	24	
" "	Disp.	"				5/16	9/5	3.0	5.0	8.0	25	25	
" "	Packer	"				6/1	10/15	2.0	7.5	9.5		26	
" "	Cook	"				7/1	8/31	.0	2.0	2.0		27	
" "	Fireman	"				6/1	10/1	2.0	7.0	9.0	20	28	
Webb Mt.	L.O.F.	10	35	29		6/16	9/5	1.0	5.0	6.0		29	
Pinto Pk.	L.O.F.	2	34	30		6/26	9/5	.5	5.5	6.0		30	
Tooley Lake	F.	23	37	28		7/1	8/31	.0	4.5	4.5		31	10,985.00
Big Creek	T.D.	32	35	29	73							(18)	
" "	Crew	"			80							(23)	
						Normal season 59 pay periods at $185+$70 = $10,985							
						Overload 6 men at $130 = 780							
Libby R.S.	R.Alt.	35	31	31		4/21	11/15	5.0	10.0	15.0	25	32	
" "	Disp.	"				6/1	9/5	2.0	5.0	7.0	25	33	
" "	Packer	"				6/1	10/15	2.0	7.5	9.5		34	
" "	F.	"				6/1	9/30	2.0	6.5	8.5	20	35	
Big Swede Mt.	L.O.F.	17	30	30		6/16	9/5	1.0	5.0	6.0	10	36	
Blue Mt.	"	32	32	30		6/21	9/5	.5	5.0	5.5		37	
Tony Pk.	"	19	30	29		6/26	9/5	.5	5.0	5.5		38	10,397.00
Libby R.S.	T.D.	35	31	31	72							(24)	
" "	Crew	"			80							(29)	
						Normal season 57 pay periods at $181+$80 = $10,397							
						Overload 6 men at $130 = 780							
Other points on this district are not necessary to Zone of Influence													
Raven Ranger Dist.	Alt.	2	26	29		4/21	10/20	5.0	8.0	13.0	25	39	
" " "	Disp.	"				5/16	9/5	3.0	5.0	8.0	25	40	
" " "	F.	"				7/1	9/5	.0	5.0	5.0	20	41	
West Fisher	F.	9	26	30		7/6	8/31	.0	4.0	4.0		42	
" "	P.G.	"				7/1	9/15	.0	5.0	5.0		43	
Kenelty Mt.	L.O.F.	22	27	29		6/16	9/5	1.0	5.0	6.0		44	
Morse Mt.	L.O.F.	33	28	30		6/26	9/5	.5	5.0	5.5		45	
Teeters Mt.	L.O.F.	28	27	30		6/26	9/5	.5	5.0	5.5		46	9,412.00
Raven Sta.	T.D.	2	26	29	73							(30)	
W. Fisher	Crew	9	26	30	85							(35)	
					Normal season 52 pay periods at $181 + $95 = $9,412								
					Overload 7 men at $130 = 910								
					Forest total regular 46 cost $59,251								59,251.00
					Overload total 35 est. 4,680								

General national forest administration and fire control

The cost of operating the national forest is discussed here under three headings: overhead, basic fire control, and additional fire suppression. As with Study 2, the Study 4 plan requires the establishment of an additional ranger district with its extra personnel. The extra overhead charges resulting from this new district would be virtually the same as in Study 2 itemized in table 89. The net increase in overhead administration costs of Study 4 over the present would thus be $12,190 a year. The Study 5 plan would involve no increase of overhead costs.

Fire control would become an especially difficult task during the period of dam construction. The basic control organization would, therefore, have to be increased during that period along the lines discussed on page 217. Costs would be upped $27,000 a year. Table 93 itemizes the basic fire control needs during that period. Following construction of the dam the basic costs would drop, but they would still be higher than if there were no dam. The postdam costs of Study 4 are itemized in table 124. The postdam costs of Study 5 would be the same as those of Study 3, itemized in table 95 (figure 68). Table 125 summarizes these cost figures. The basic requirements to handle fire danger conditions rated 70 or less are shown in column 1. The additional costs which would be involved when the fire danger climbs above 70 are shown in column 3.

Table 125. Present and future cost of the basic fire control organization in the Zone of Influence

	Total annual cost	Increase over Study 0	Overload
	Dollars		
Present (Study 0)	47,312	-	8,206
Construction period	74,622	27,310	8,206
After construction			
Study: 1 and 2	58,888	11,576	7,150
3	49,897	2,585	7,020
4	59,251	11,939	4,680
5	49,897	2,585	7,020

Occasionally fires grow beyond the capacity of the basic fire control organization (including the overload organization) to cope with them. In such cases additional suppression forces must be organized. Table 96 shows the additional cost of fighting big fires has averaged $30,000 annually in the Zone of Influence over a period of 20 years. It is estimated that these costs would have run slightly higher under the Study 4 conditions than under Study 0 conditions. On the other hand it appears that the Study 5 road plan might have permitted a slight reduction of suppression costs: Study 0, $30,256 a year; Study 4, $34,334 a year (same as Study 2); and Study 5, $29,652 a year (same as Study 3).

Big game and fisheries management

Construction of a dam at River Mile 217.0 would have little if any effect upon game management in the Fisher River and Libby areas. A dam at this location would, however, have the same effects upon game management in the Gateway-Jennings area as a dam at the lower site. These effects are discussed on page 230. The relation of the dam to fisheries management would be the same as if the dam were at the lower site. The fisheries problem is discussed on pages 232 to 234.

Recreational development

A change in the dam location from River Mile 204.9 to 217.0 would alter the recreational situation to some extent. Sites 1, 2, 3, 4, and 5 (figure 61) would be below the dam. Even so, there are alternatives to sites 1, 2, 3, and 4 along the river which should be included in the recreational planning. They would be away from the clearing operations and thus have some advantages over sites situated above the dam during the construction period. There is no river level alternate to site 5 so it should be dropped from consideration if the dam is built at the upper location.

It is possible that the ultimate recreational load would be smaller with the dam at River Mile 217.0 instead of River Mile 204.9 because the distance from Highway 2 would be greater and the lake smaller. In any case, the 14 sites described in pages 237 to 243 should be adequate to meet all recreational demands for many years in the future.

The recreational pressures during the period of dam construction should be equally great wherever the dam is built. It would be highly desirable, therefore, for reasons of safety and sanitation, that sufficient sites be developed as part of the dam project to care for a maximum of 400 picnickers and campers daily. The development should include fireplaces, tables, drinking water, and sanitary facilities. At $100 a person the total cost would be $40,000.

APPENDIX I. IMPACT OF DAM UPON THE TOBACCO RIVER WORKING CIRCLE

The Tobacco River Working Circle lies in the northeast corner of Lincoln County and extends into Flathead County. It is entirely outside the Zone of Influence. This working circle would, however, feel certain secondary effects of the dam which are discussed briefly here.

Description of area

The Tobacco River Working Circle (or the Fortine Ranger District) lies entirely within the Kootenai National Forest in Lincoln and Flathead Counties. It is bounded on the north by Canada, on the east by the Flathead National Forest, and on the west and south by the Libby Working Circle. The community within this circle includes about 2500 people residing in Eureka, Fortine, and Trego, and on a number of small farms. All depend chiefly upon forest products as a means of livelihood. Fifty-five percent of the basic income of these people is derived from forest products--lumber, railroad ties, and Christmas trees. Farm products account for 38 percent of the basic income and 7 percent comes from other sources. There are about 40 small circular sawmills within the area with individual capacities ranging from 5,000 to 25,000 board feet a day. A large part of the cut is in the form of two-by-fours and railroad ties.

The Great Northern Railway transcontinental line presently bisects the working circle. It is paralleled by a state highway. A system of county and Forest Service roads connects with the highway giving access to railroad points at Eureka, Fortine, Tobacco Siding, Trego, and Stryker. This provides a very favorable means of transporting all products to outside markets.

Approximately 369,000 acres of land lie within the working circle. This acreage is divided by ownership as follows:

National forest	254,666 acres
Other owners	113,680 acres
Total	368,346 acres

About 89,000 acres of the above total are brush, barren, subalpine, and cultivated lands. The remaining 279,000 acres are commercial forest. The United States Government owns about 74 percent of this commercial forest.

The topography of the working circle varies from gently rolling hills along the valley bottoms to extremely steep and broken slopes. Elevations vary from 2400 to 7400 feet above sea level. Most of the commercial timber lands are below 5000 feet. About one-half the larch-fir and yellow pine types may be logged in the winter months. The remainder of these and the spruce types offer only summer logging chances.

The present sawtimber inventory amounts to about 883 million board feet, divided by ownership as follows:

Ownership	Sawtimber	Poles
	Thousand bd.ft.	Pieces
National forest	839,900	1,954,000
Other	42,800	65,000
Total	882,700	2,019,000

A management plan prepared for 1952 set the annual allowable cut of sawtimber material from this working circle at 12 million board feet. This plan, though as yet unapproved, contains the best information of timber resource at the present time. In 1951 the above-estimated allowable sawtimber cut was considerably exceeded, but during the preceding decade the allowable and actual cuts were more or less in line on the average.

Following are the lumber shipments from this area in 1951: Eureka 16,000,000 board feet, Fortine 6,350,000 board feet, Tobacco 500,000 board feet, Trego 75,000 board feet, total 22,925,000 board feet. This lumber production consisting of boards, 2 x 4's, and railroad ties, filled some 968 railroad cars. About one-fifth of the total lumber production was railroad ties which were mainly shipped to Somers, Montana for treatment and use in the Great Northern and Chicago, Burlington, and Quincy Railroads. The 2 x 4's were largely marketed in Texas, Arkansas, Oklahoma, the Dakotas, Colorado, and eastern Montana. Most of the other lumber went to e astern Montana and the Dakotas. It is estimated that 183 cars of Christmas trees were shipped in 1951 mainly to Chicago, St. Louis, Kansas City, and San Francisco. The Christmas tree industry supplies an important income for the Tobacco River Working Circle.

Forest area statistics tell an important story. Following is the percentage of each type in the total forest area: larch 58 percent, lodgepole pine 19 percent, spruce 13 percent, Douglas-fir 5 percent, and ponderosa pine 5 percent. Only ponderosa pine, and possibly spruce, can be considered high-quality and high-value species. With this dependence upon low-margin timber the Tobacco River forest industry is probably more vulnerable to economic changes than most areas.

Impact of dam

Construction of the Libby dam would necessitate relocation of the Great Northern Railway to remove it from the Kootenai River valley between Libby and Eureka. Its ultimate route, of course, is a matter of vast importance to the Tobacco River Working Circle.

One possibility is to relocate the mainline southerly from Libby along Highway 2 to Marion and from there to the present line at Whitefish. If the track from Whitefish to Eureka were left in as a branch line,

the net effect on the Tobacco River Working Circle would be small except as services might be curtailed. Removal of the line would, of course, blight the whole area.

It seems more likely that the mainline would be relocated through the southern end of the Tobacco River Working Circle along Fortine Creek. Many carloads of products originate in the Eureka area each year, so it hardly seems likely the branchline between there and Stryker would be abandoned. However, if it were, the net effect would be to increase the cost of transporting forest products in the Tobacco River Working Circle by about $23,000 annually. If the branchline were maintained, annual transportation costs would be $12,000 to $15,000 less than with existing facilities.

F I G U R E S

T A B L E S